

Graphic  
History  
of  
Architecture

**PDFBOOKSFREE.PK**

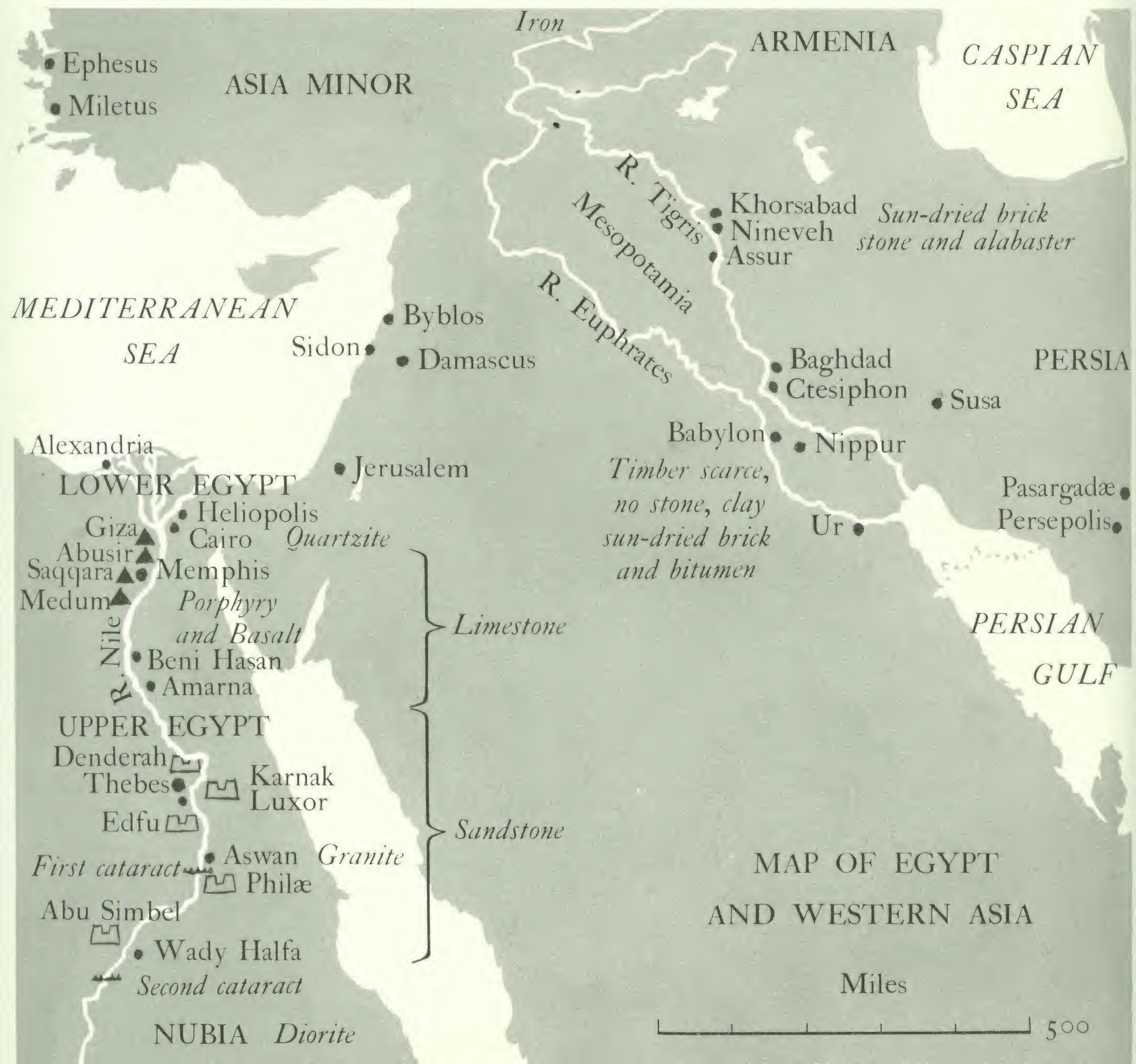


JOHN  
HANSBRIDGE



# EGYPT

THE ARCHAIC PERIOD		THE OLD KINGDOM				First Intermediate Period	THE MIDDLE KINGDOM		Second Intermediate Period
Dynasty I	II	III	IV	V	VI		IX	XII	
c.3200 B.C.	2980	2789	2680	2565	2420	2258	2134	1991	1786
Union of Upper and Lower Egypt Capital: Heliopolis		Capital: Memphis The Age of the Pyramids					The Feudal Age Capital: Thebes		Invasion of the Hyksos from Asia

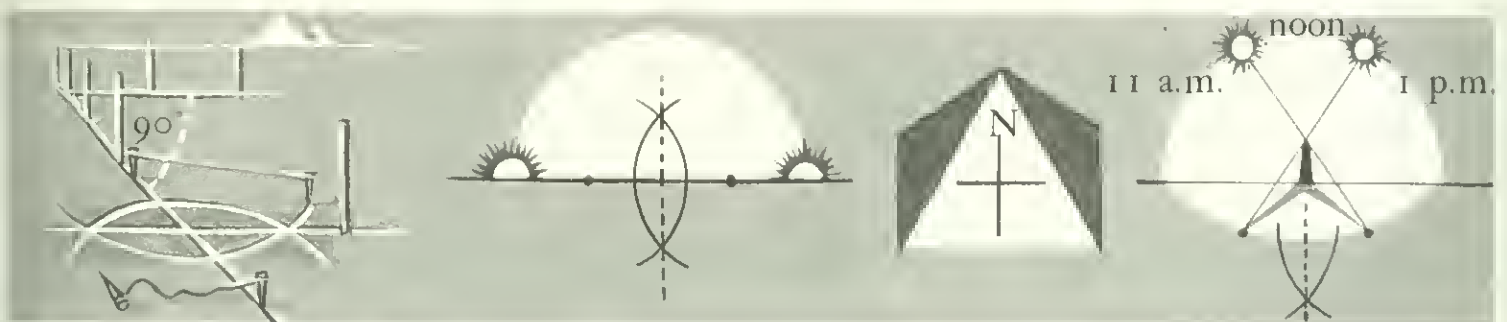
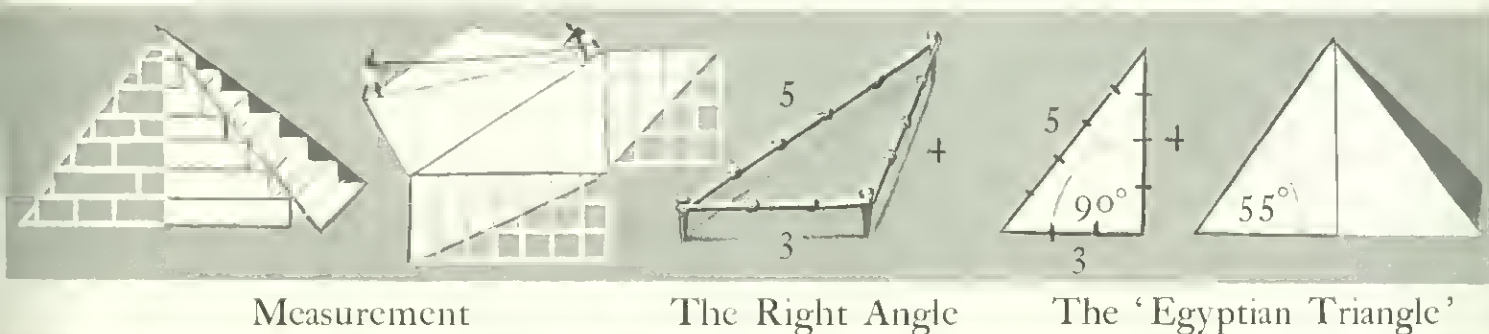




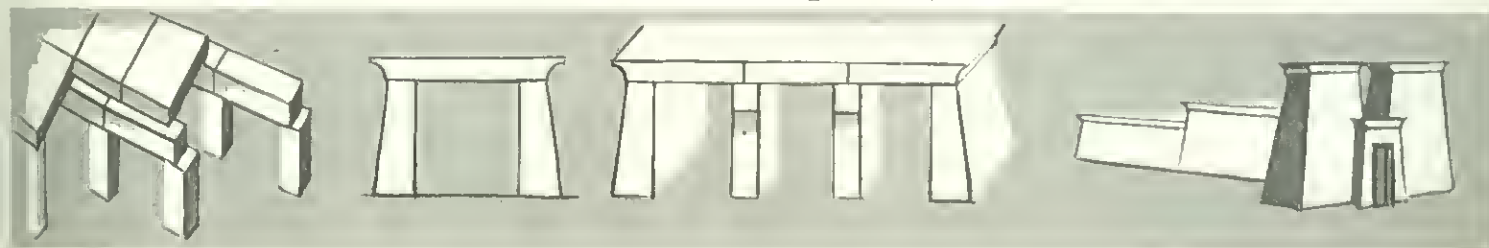
# INTRODUCTION

THE NEW KINGDOM				THE LATE PERIOD			THE PTOLEMAIC PERIOD	
XVIII	XIX	XX		XXI	-	XXXI		
1570	1314	1197	1085		671-663	525	332	30 B.C.
The Egyptian Empire in Asia and Nubia Capital: Thebes					Assyrian invasion	Domination of Persia		Egypt a Roman province

Egypt was a narrow strip of highly productive soil, 8 to 12 miles wide, along the banks of the Nile, about one-fifth of the area of England and Wales. From pre-dynastic times sun-dried mud bricks were used for houses, but these have not survived: timber was scarce and hence arches were built without centering. There was however an abundance of limestone, sandstone and granite. The planning of irrigation canals and fields, necessitated by the annual inundations of the Nile, demanded a system of geometry (Gk land measuring). Believing in a life after death, the Egyptians thought that the body should be preserved in a lasting tomb; this became a geometric construction of great solidity and permanence.



Method of orientating the pyramids



Temples constructed with columns, beams and massive, battered external walls



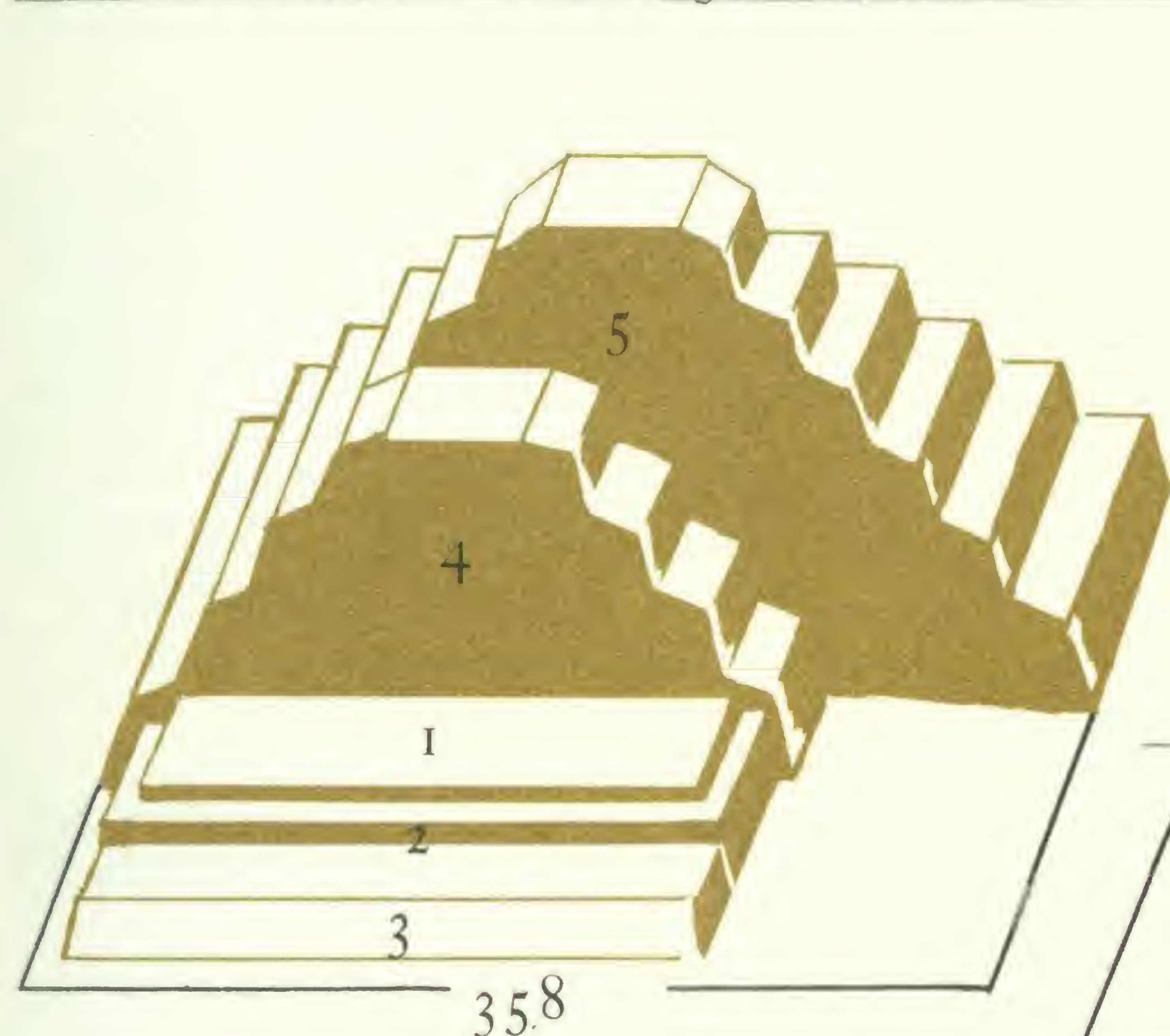
# EGYPT

Pit graves in desert cemeteries:  
sand heap A surrounded by  
circle of stones B over grave C

Pit graves transformed into  
tombs by brick lining and flat  
wooden or arched brick roofs

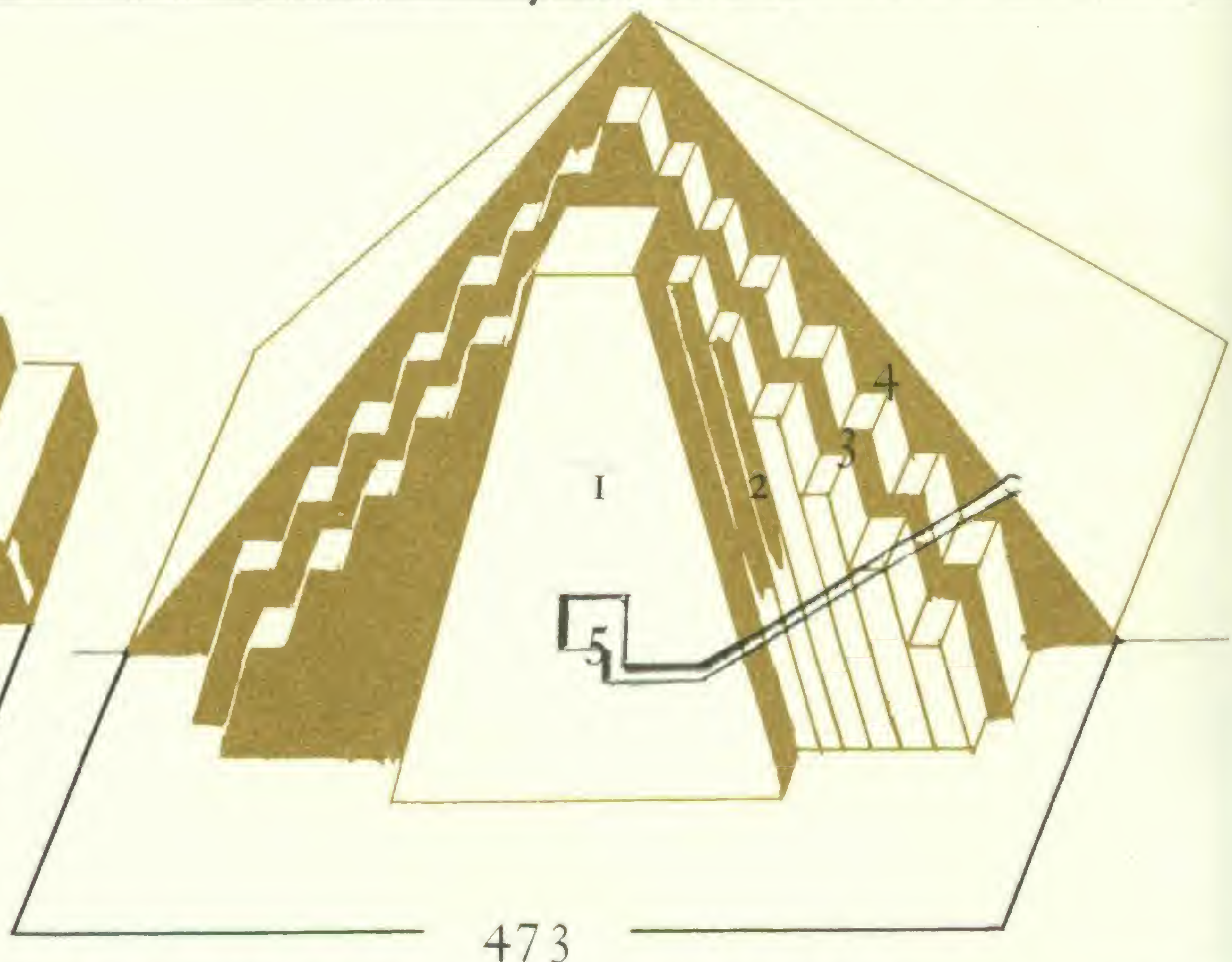
Walls of  
sun-dried  
brick

Beginning  
of *stone*  
masonry



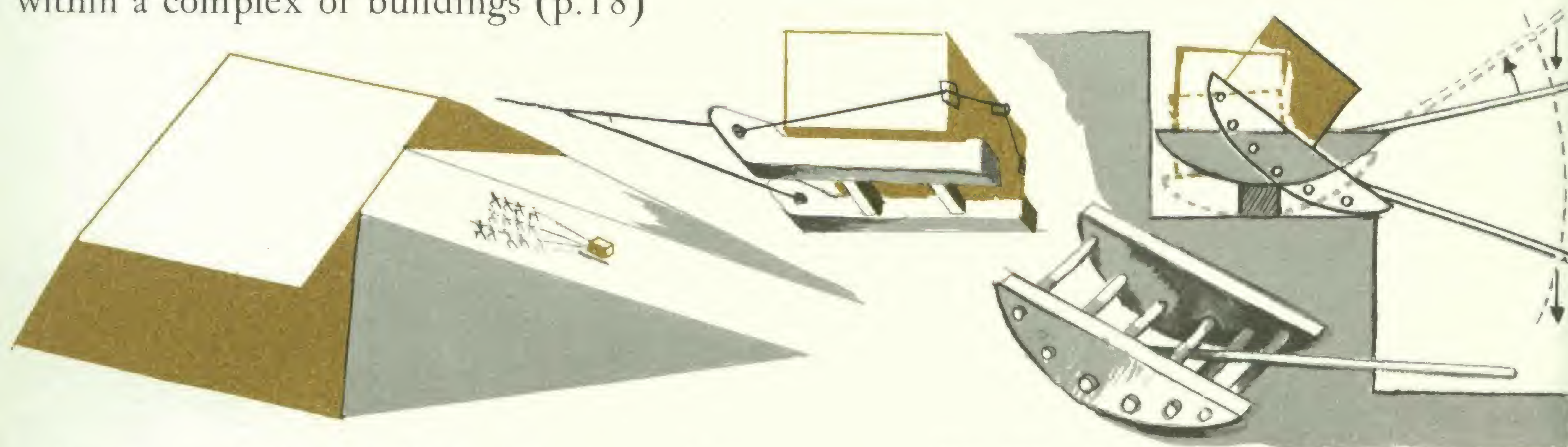
THE STEP PYRAMID, Saqqara,  
Dynasty III: Section looking west  
Built by Imhotep, architect to  
King Zoser.

1 Begun as a mastaba-tomb. 2-5 Then  
successively enlarged, in limestone. Set  
within a complex of buildings (p. 18)



THE PYRAMID OF MEDUM, Dynasties III-IV  
Section looking west, reconstructed

1 Centre core. 2 Successive layers added, at about  
75°, each of local stone and cased with limestone.  
3 Enlargement of the pyramid. 4 Steps filled in  
with a facing of limestone. 5 The tomb chamber



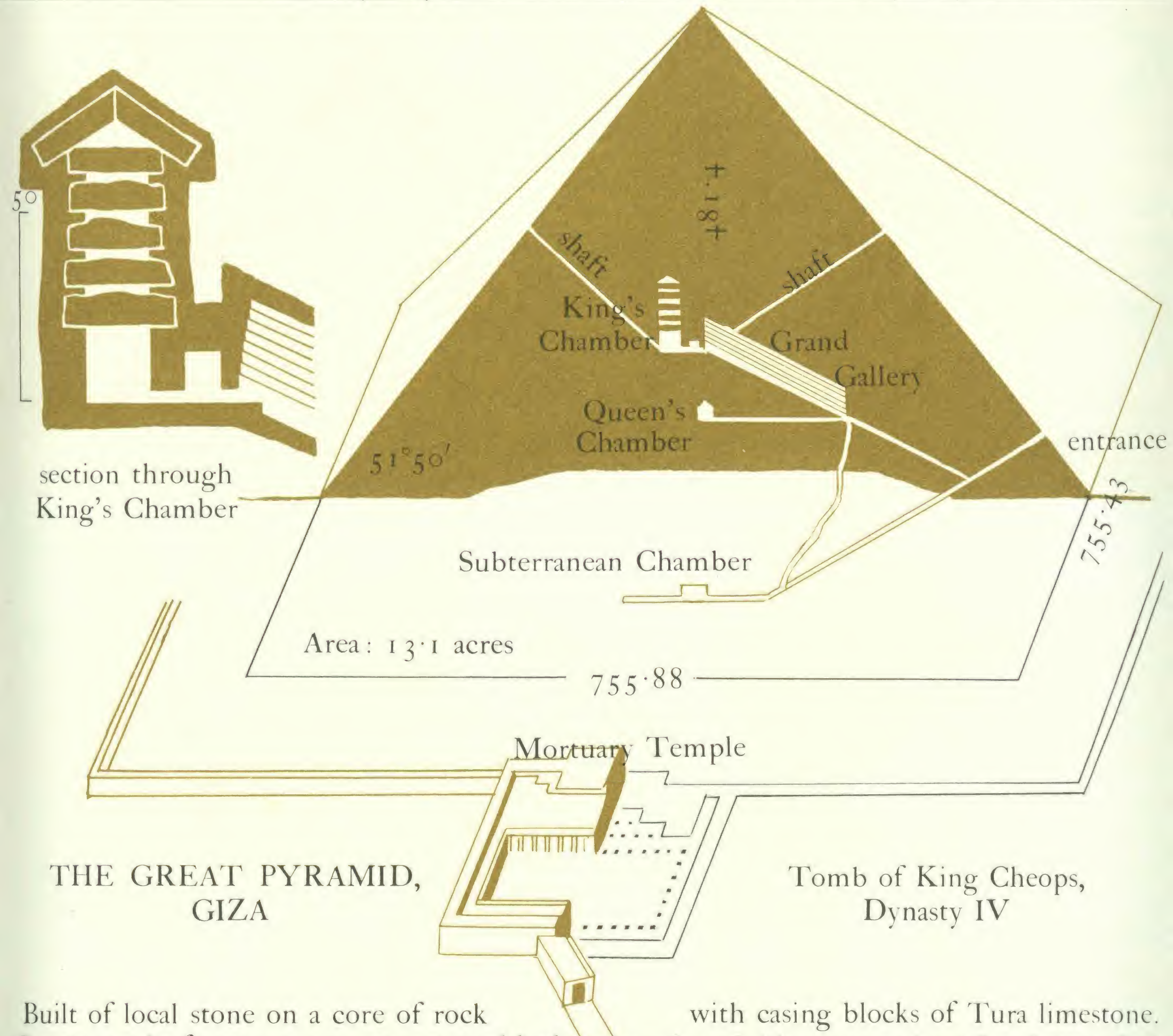
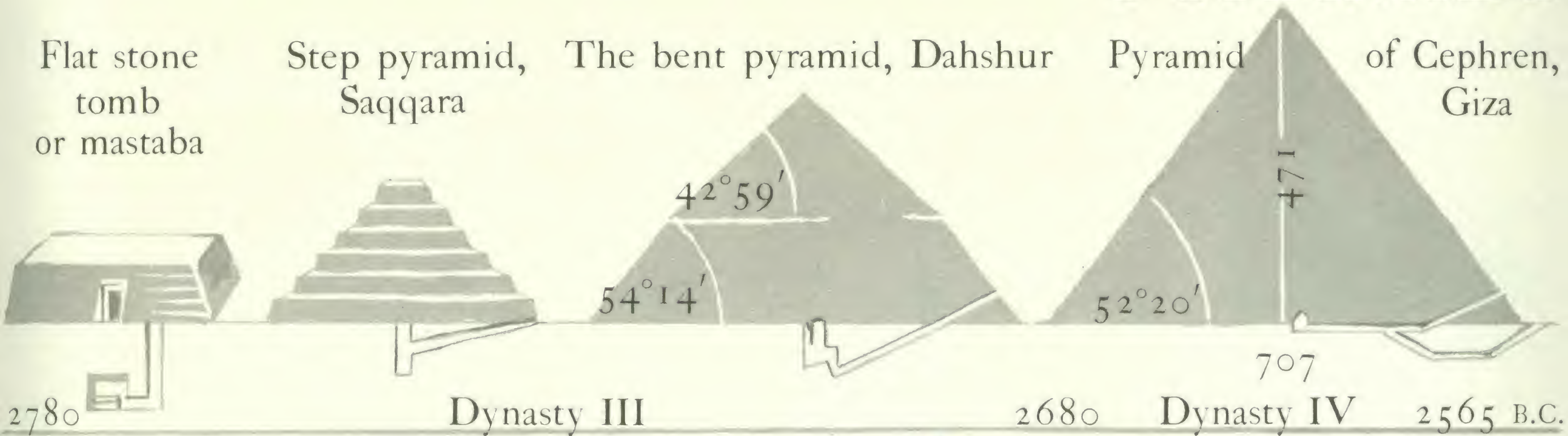
Stones on sledges, pulled up long earth ramps

The Rocker; pulleys were unknown

Suggested methods of hauling and lifting stones



# PYRAMIDS



Built of local stone on a core of rock with casing blocks of Tura limestone. Constructed of some 2,300,000 stone blocks, each weighing approximately  $2\frac{1}{2}$  tons. It is probable that for a period of twenty years 100,000 men were levied annually, during the three months' inundation of the Nile (July to October), for transporting stone. Also about 4,000 permanent skilled masons and attendant labourers were employed



# EGYPT

THE OLD KINGDOM  
Dynasties III-VI, 2780-2258 B.C.  
The Age of the Pyramids

THE MIDDLE KINGDOM  
Dynasties XI-XII, 2134-1786

The Step Pyramid, Saqqara, set within a complex of buildings of local stone faced with limestone

Built by Imhotep for King Zoser, (reconstructed) Dynasty III

The great Pyramid of Cheops, Giza, Dynasty IV

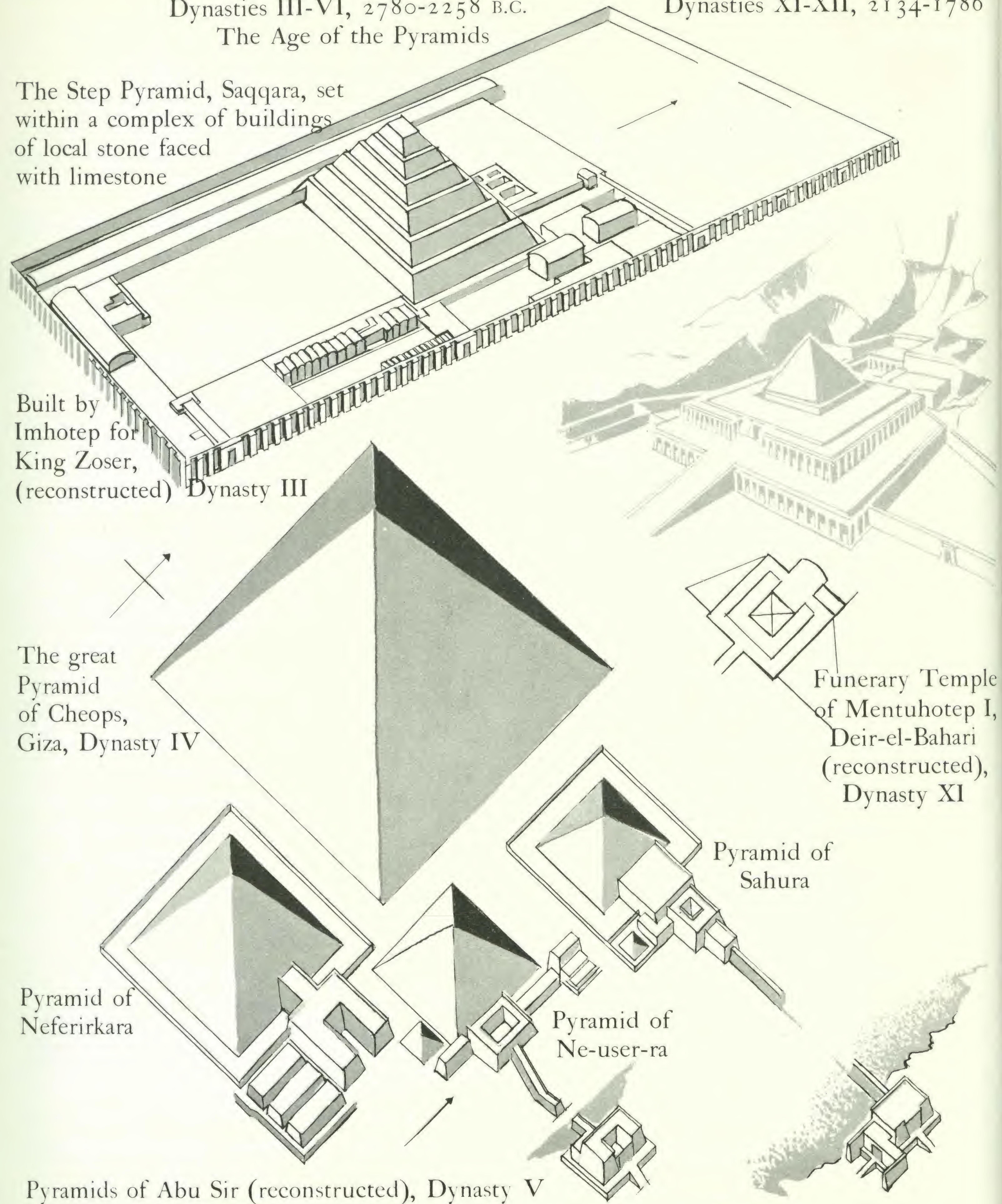
Funerary Temple of Mentuhotep I, Deir-el-Bahari (reconstructed), Dynasty XI

Pyramid of Sahura

Pyramid of Neferirkara

Pyramid of Ne-user-ra

Pyramids of Abu Sir (reconstructed), Dynasty V





# COMPARATIVE BUILDINGS & PLANS

## THE NEW KINGDOM

Dynasties XVIII-XX, 1570-1085 B.C.

The Age of the great Temples

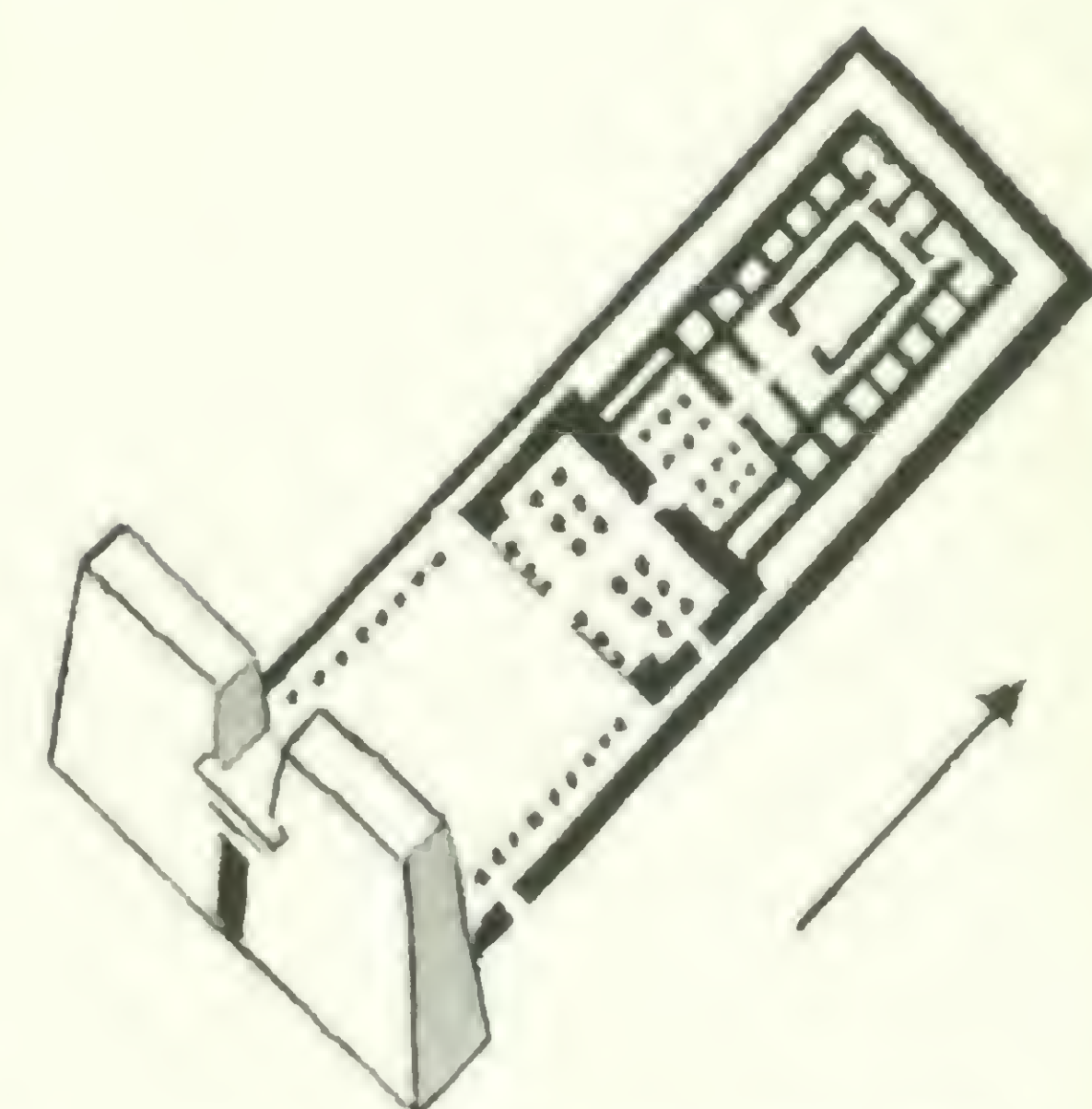
## THE PTOLEMAIC PERIOD

332-30 B.C.

Revival of Temples

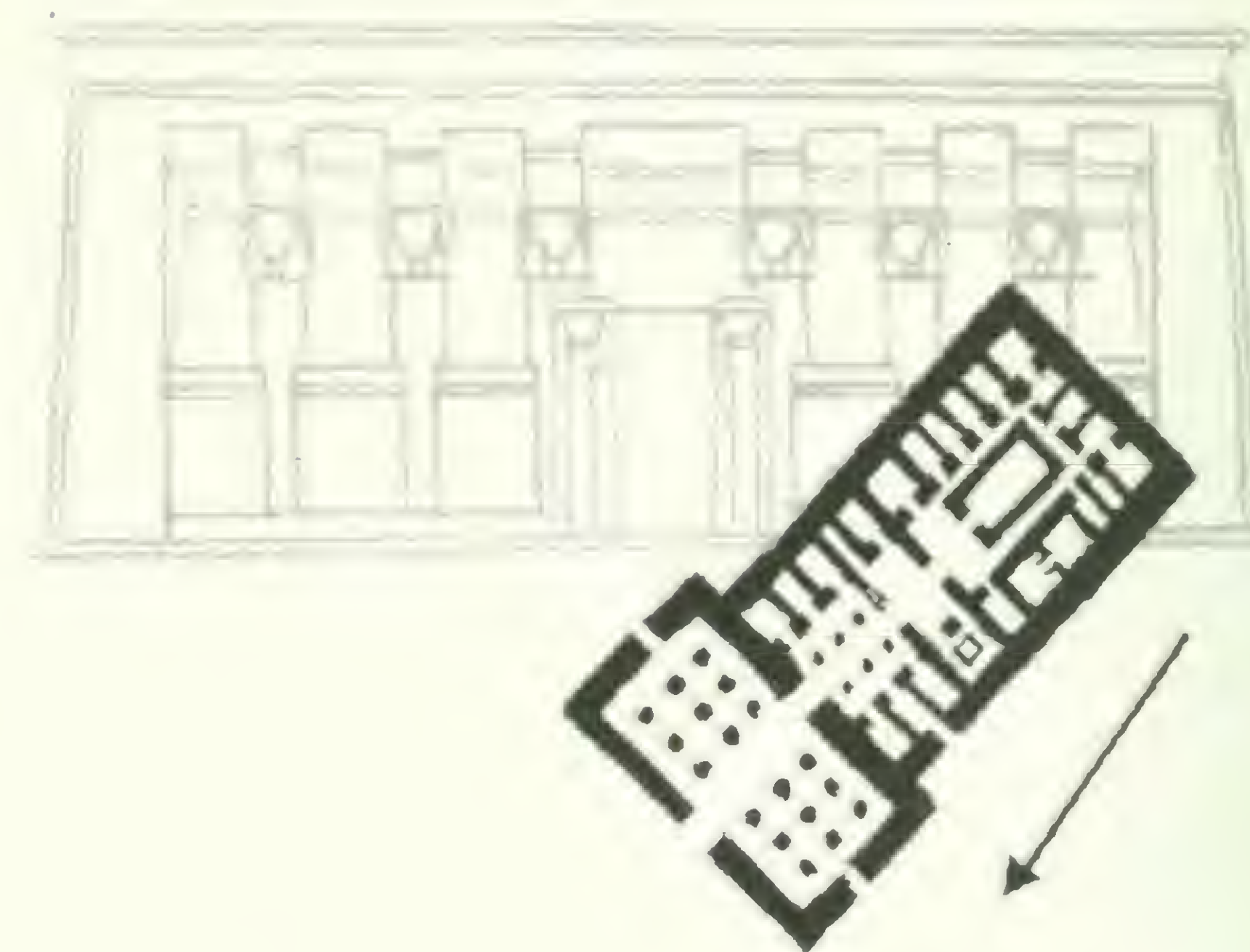
Mortuary Temple of Amon,  
Deir-el-Bahari (reconstructed),  
Dynasty XVIII

Designed by Senmut and  
built for Queen Hatshepsut



The Temple of Horus,  
Edfu, 237-212 B.C.  
Begun by Ptolemy III

The Great Temple  
of Amon, Karnak,  
Dynasties XVIII-XXXI  
(Foundations Dynasty XI)



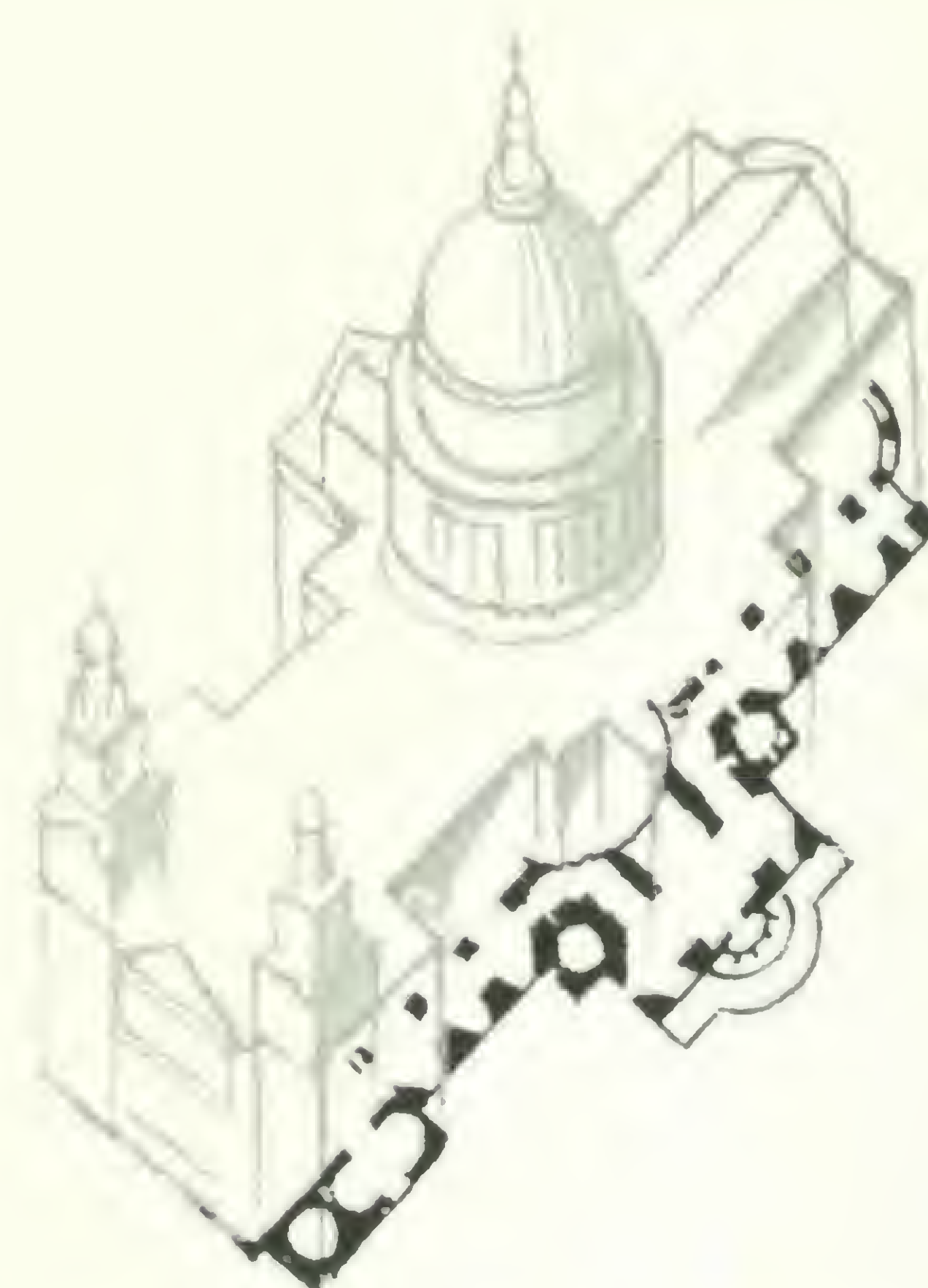
The Temple of Hathor,  
Dendera, 1st cent. B.C.

The Temple  
of Amon, Luxor,  
Dynasties XVIII-XIX  
Begun by Amenhotep III  
and added to by Rameses II

Temple of Seti I, Abydos,  
Dynasty XIX



Great Temple, Abu Simbel, Nubia,  
Dynasty XIX. Built for Rameses II



St Paul's, London

Plans and buildings in black  
drawn to the same scale

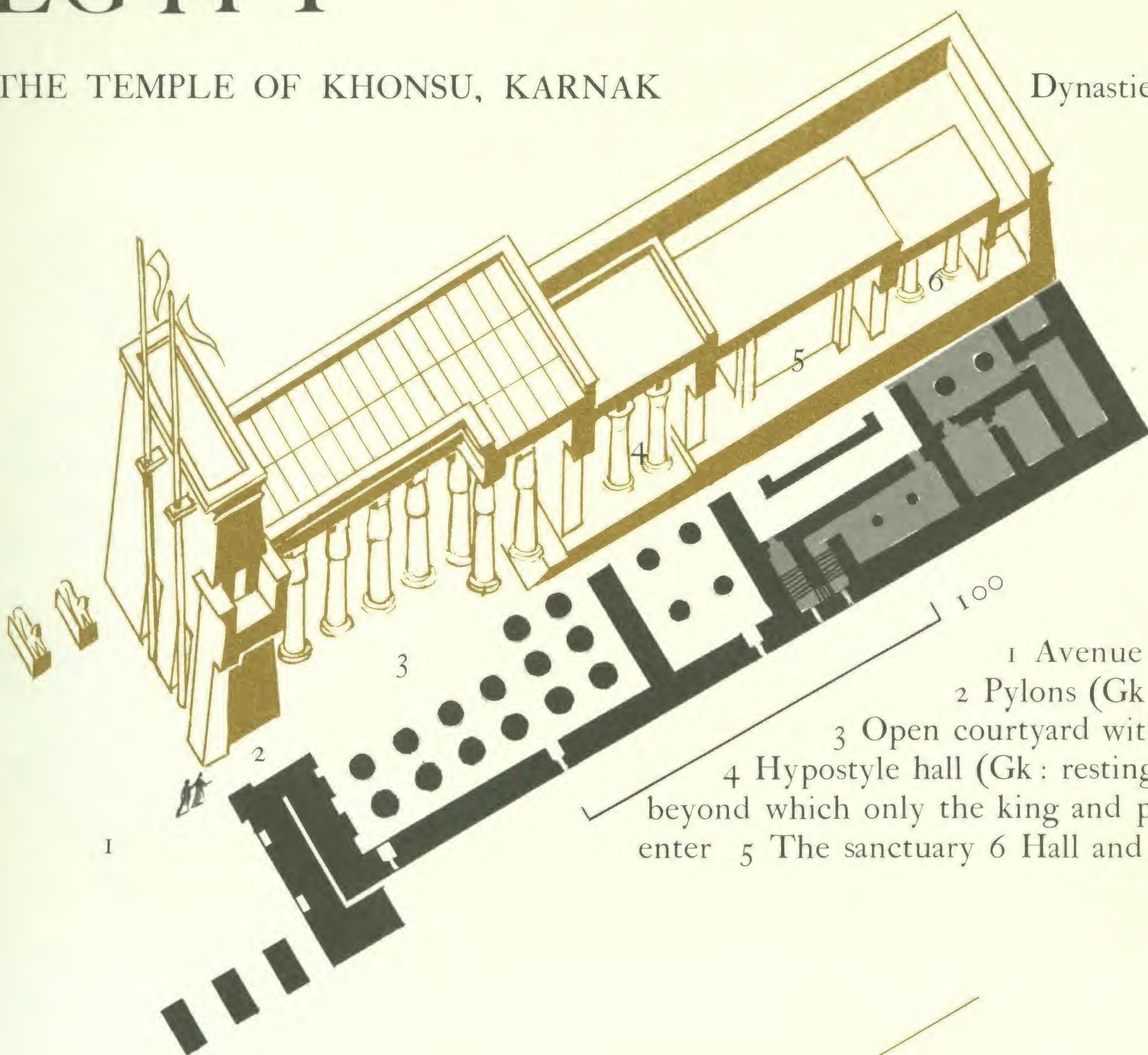
500



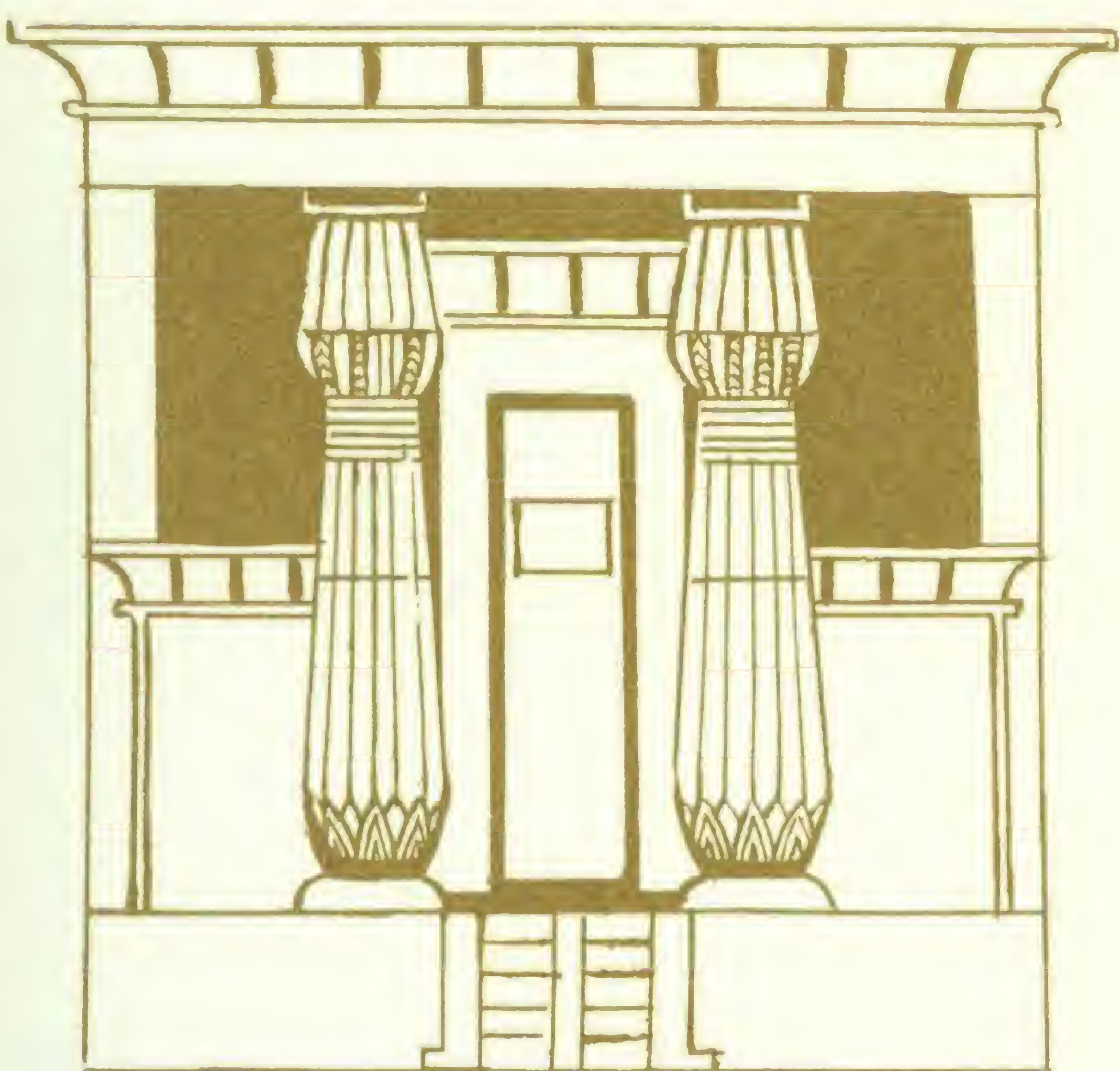
# EGYPT

## THE TEMPLE OF KHONSU, KARNAK

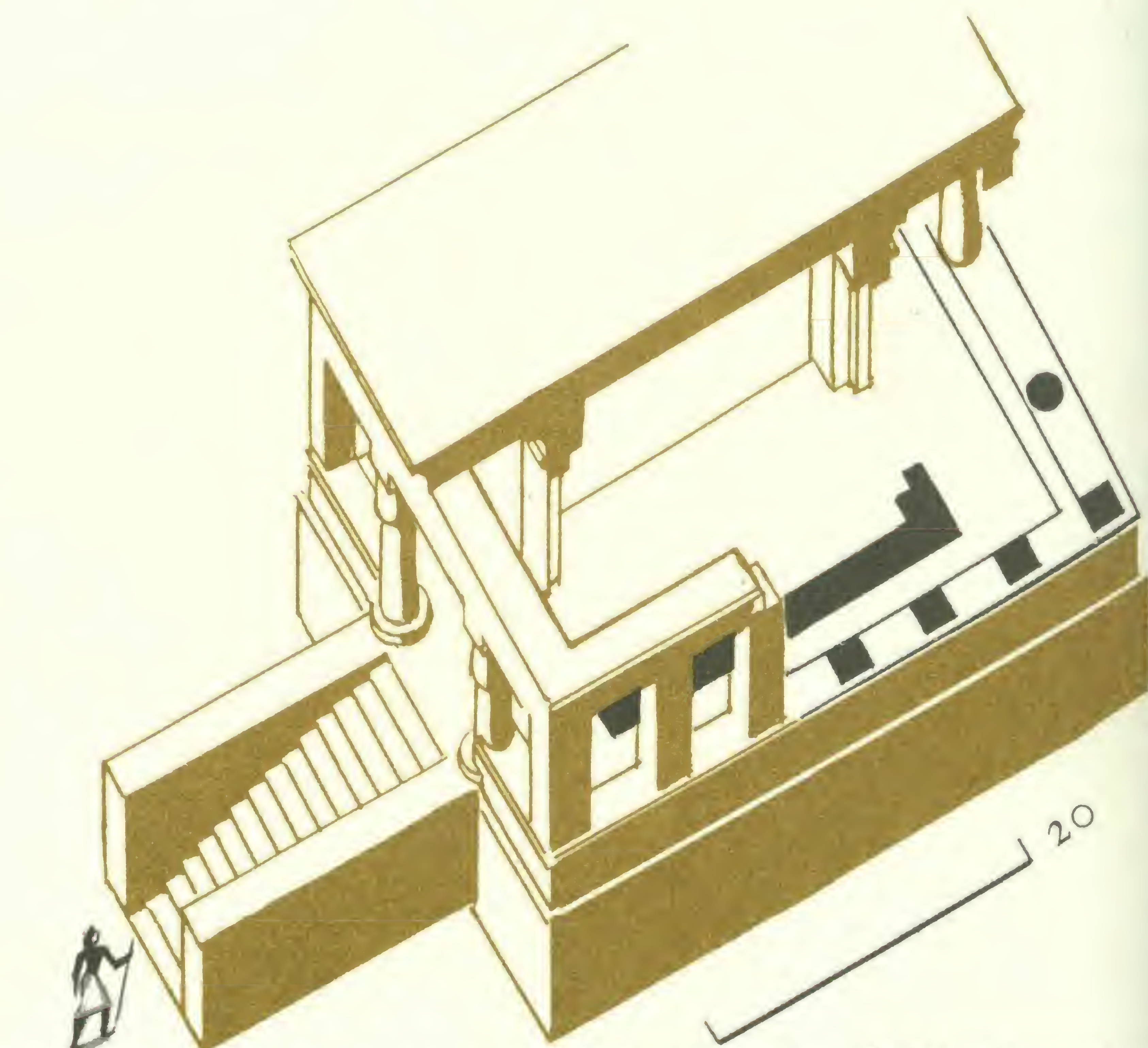
Dynasties XX-XXI



- 1 Avenue of sphinxes
- 2 Pylons (Gk : a gateway)
- 3 Open courtyard with colonnade
- 4 Hypostyle hall (Gk : resting on pillars), beyond which only the king and priests might enter
- 5 The sanctuary
- 6 Hall and store rooms



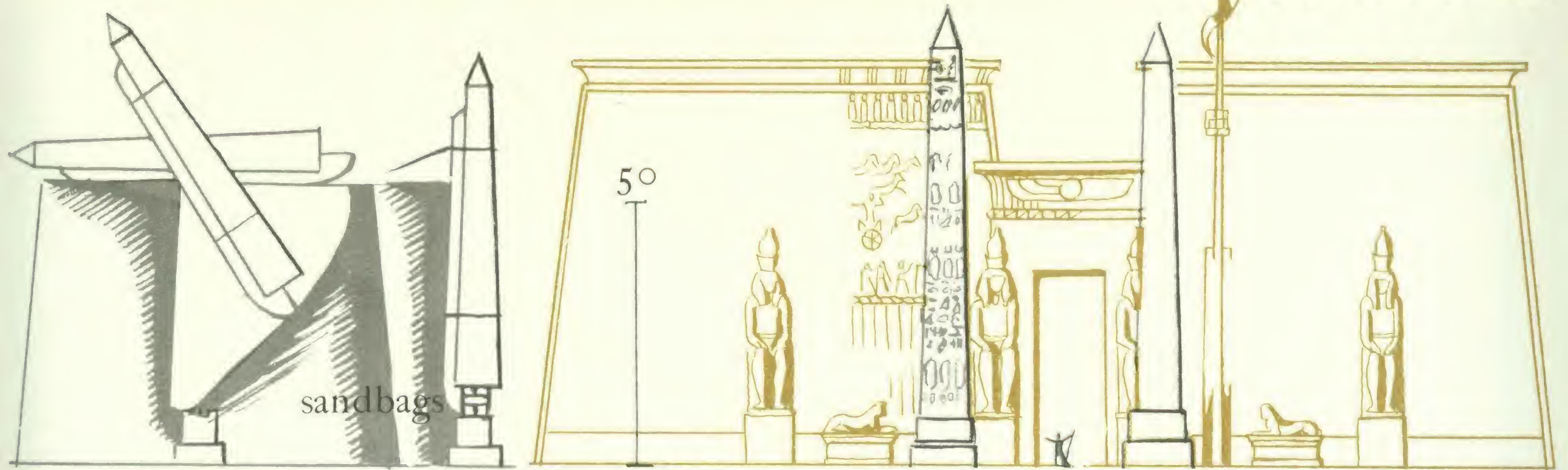
A garden shrine from a painting in a tomb, Thebes, Dynasty XIX



Temple of Amenhotep III, Island of Elephantine, Dynasty XVIII (Destroyed A.D. 1822)



# TEMPLES



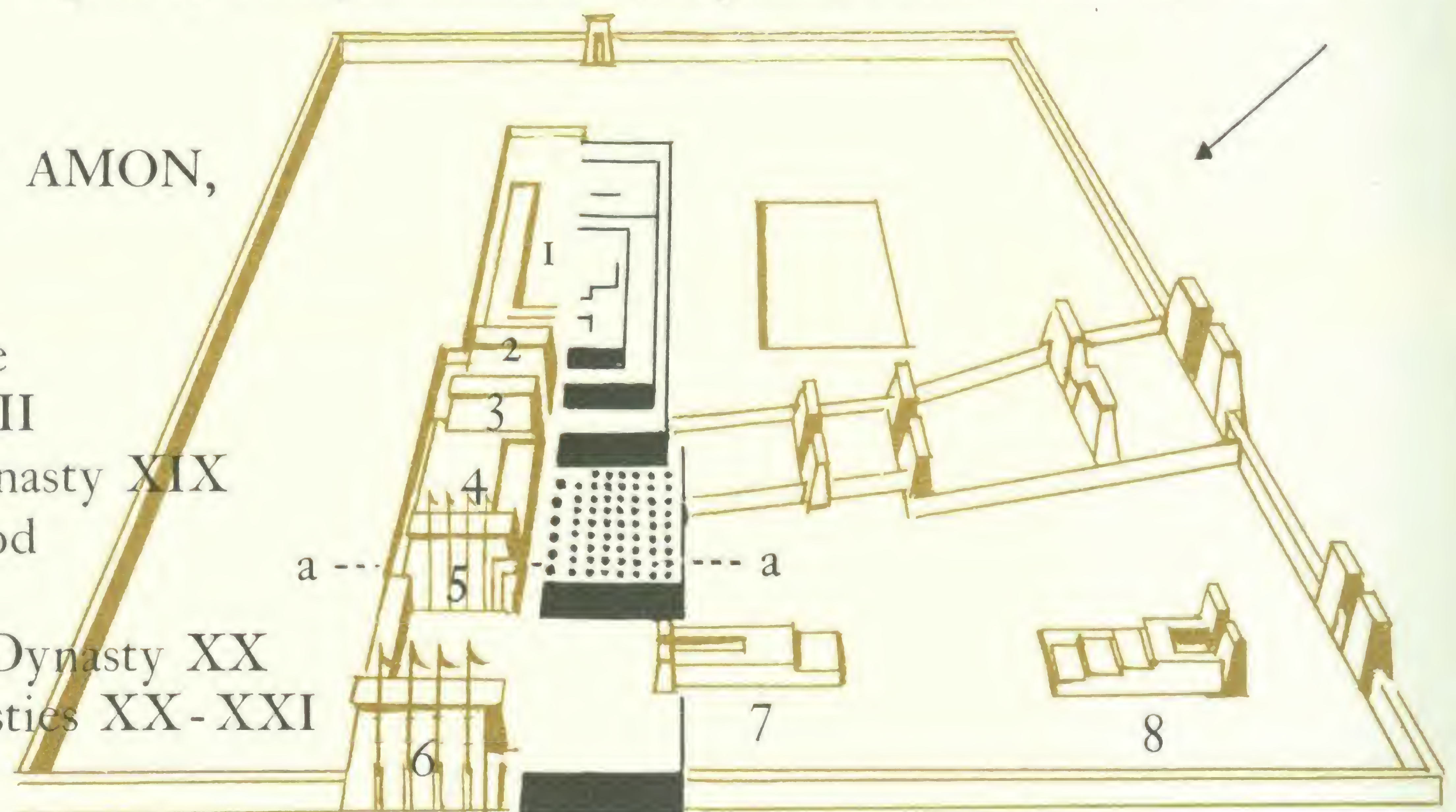
Pylons, Temple of Luxor, Dynasty XIX. Built by Rameses II

## GREAT TEMPLE OF AMON, KARNAK

Built of sandstone  
Begun Dynasty XII

1-4 Dynasty XVIII 5 Dynasty XIX

6 Ptolemaic period



7 Temple of Rameses III, Dynasty XX  
8 Temple of Khonsu, Dynasties XX-XXI

Section

Hypostyle hall, a-a

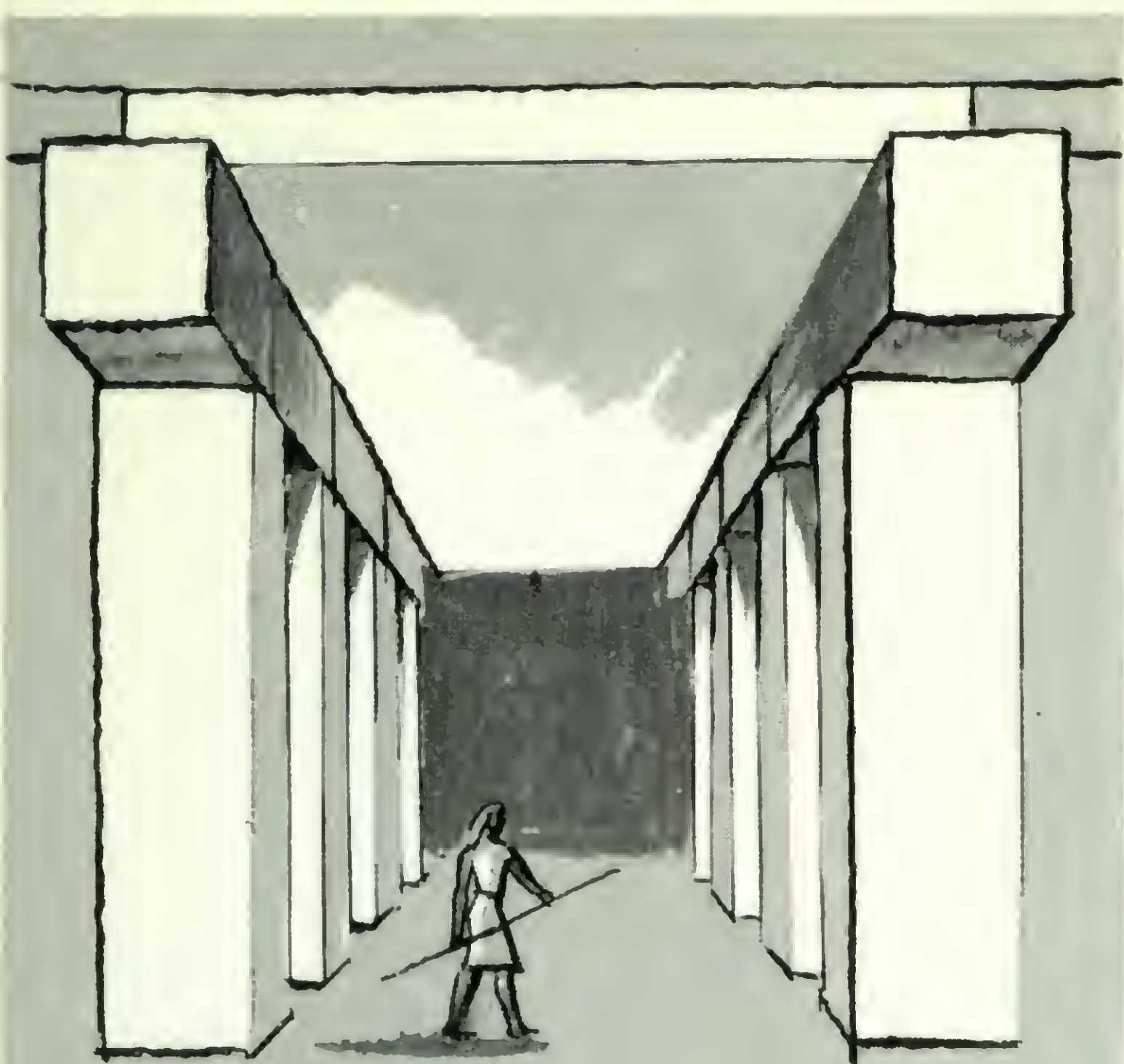
clerestory windows

hall filled with sand and roof-slabs lowered into position



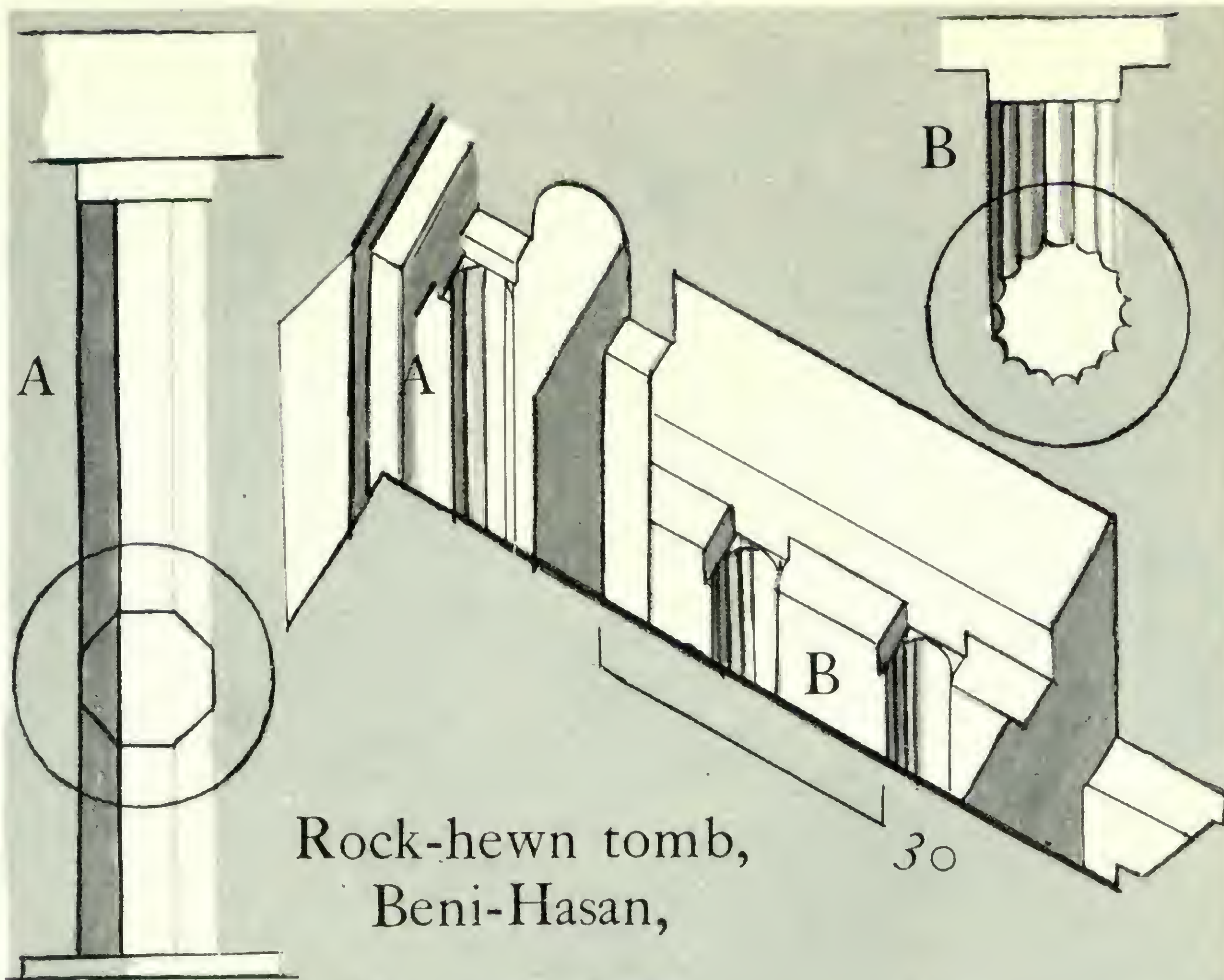


# EGYPT



Valley Temple  
built of granite:  
Pyramid of Cephren, Giza.

Dynasty IV



Rock-hewn tomb,  
Beni-Hasan,

Dynasty VII



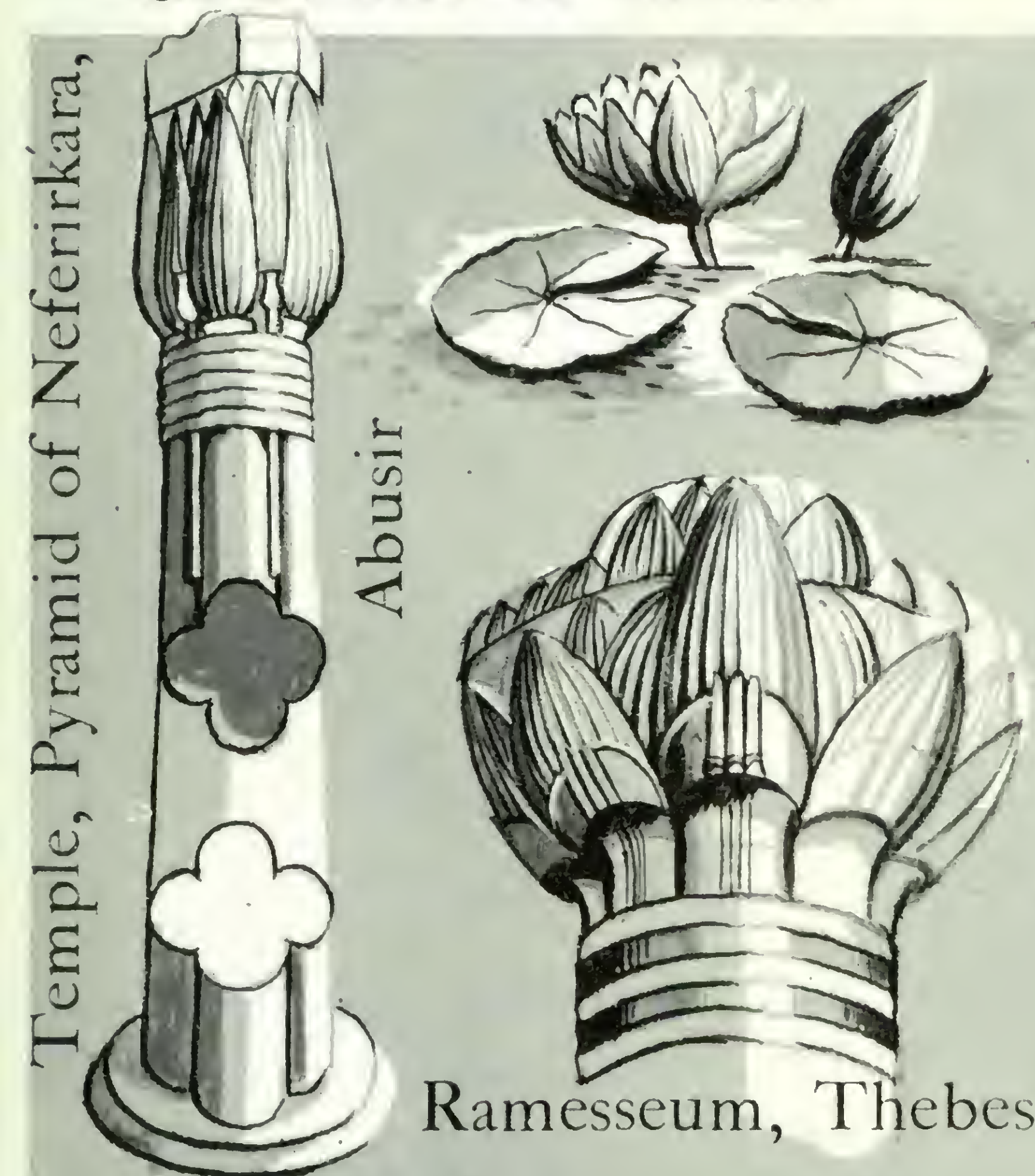
Portico, Temple-tomb,

Deir-el-Bahari

Dynasty XIX

## COLUMN & BEAM

## PROTO-DORIC COLUMNS

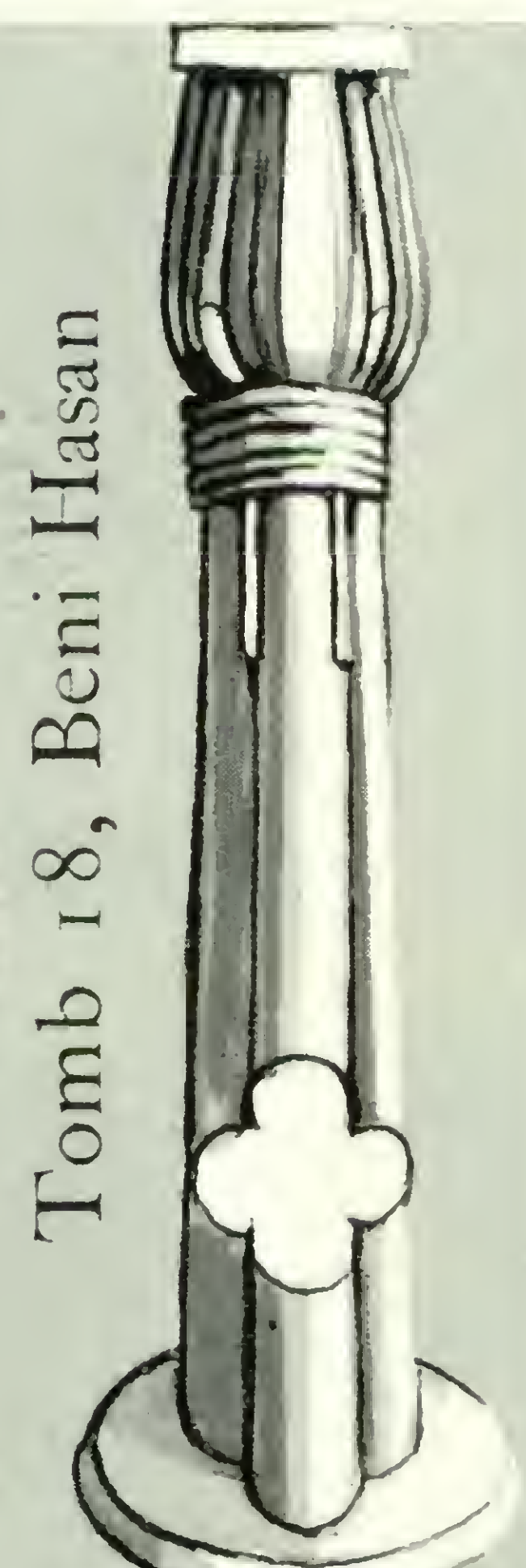


Dynasty V

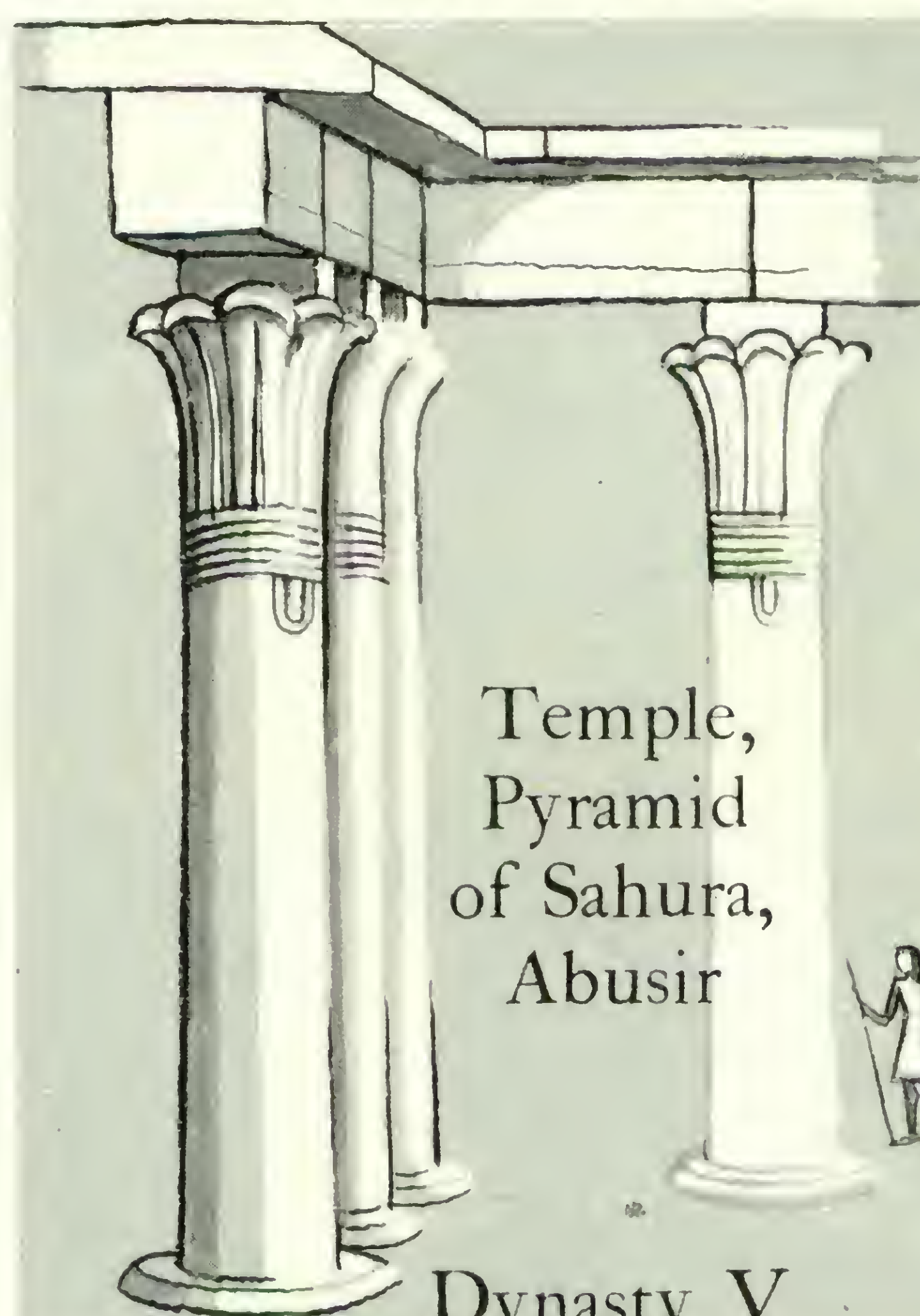


Ramesseum, Thebes

Dynasty XIX



Dynasty XI



Temple,  
Pyramid  
of Sahura,  
Abusir

Dynasty V

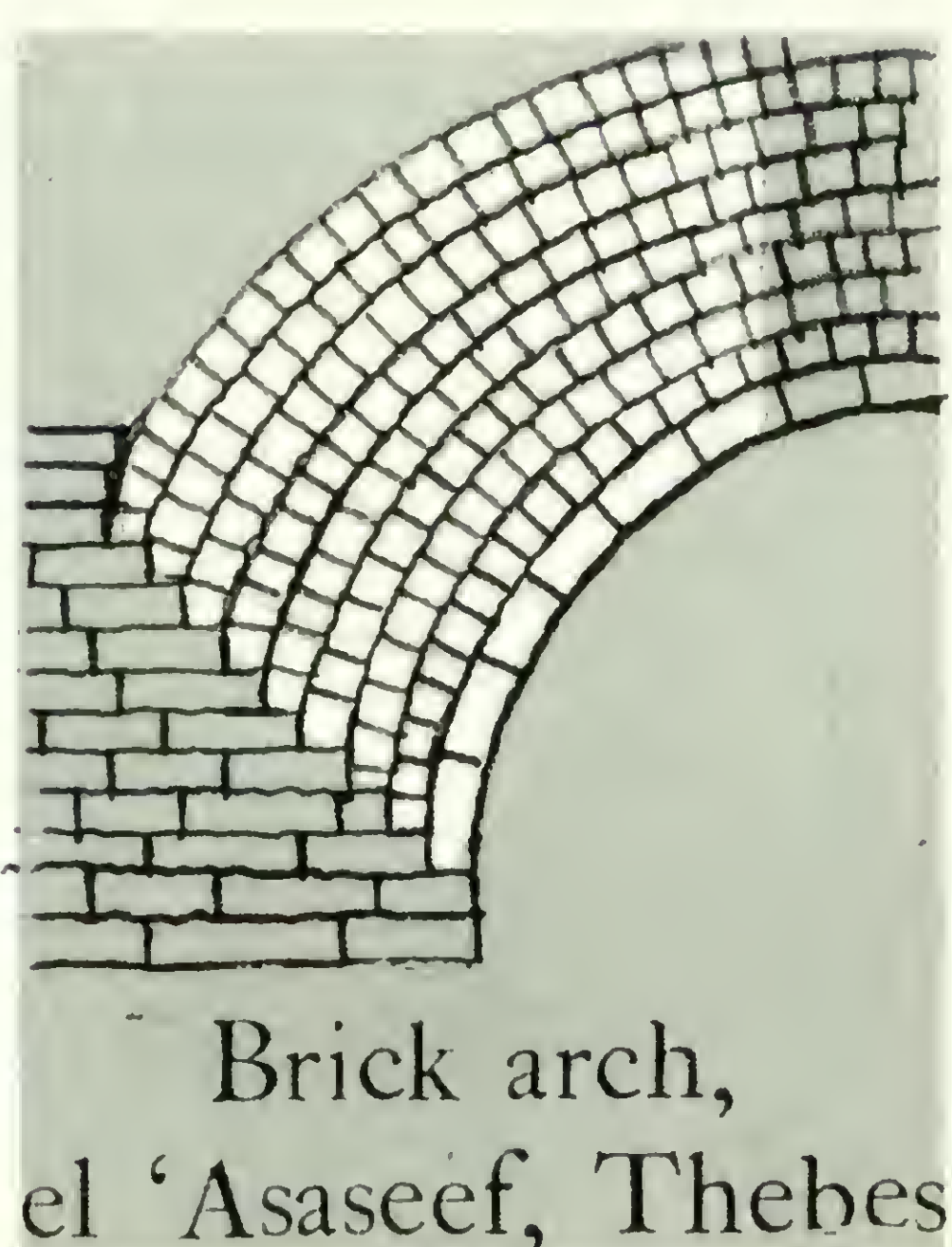
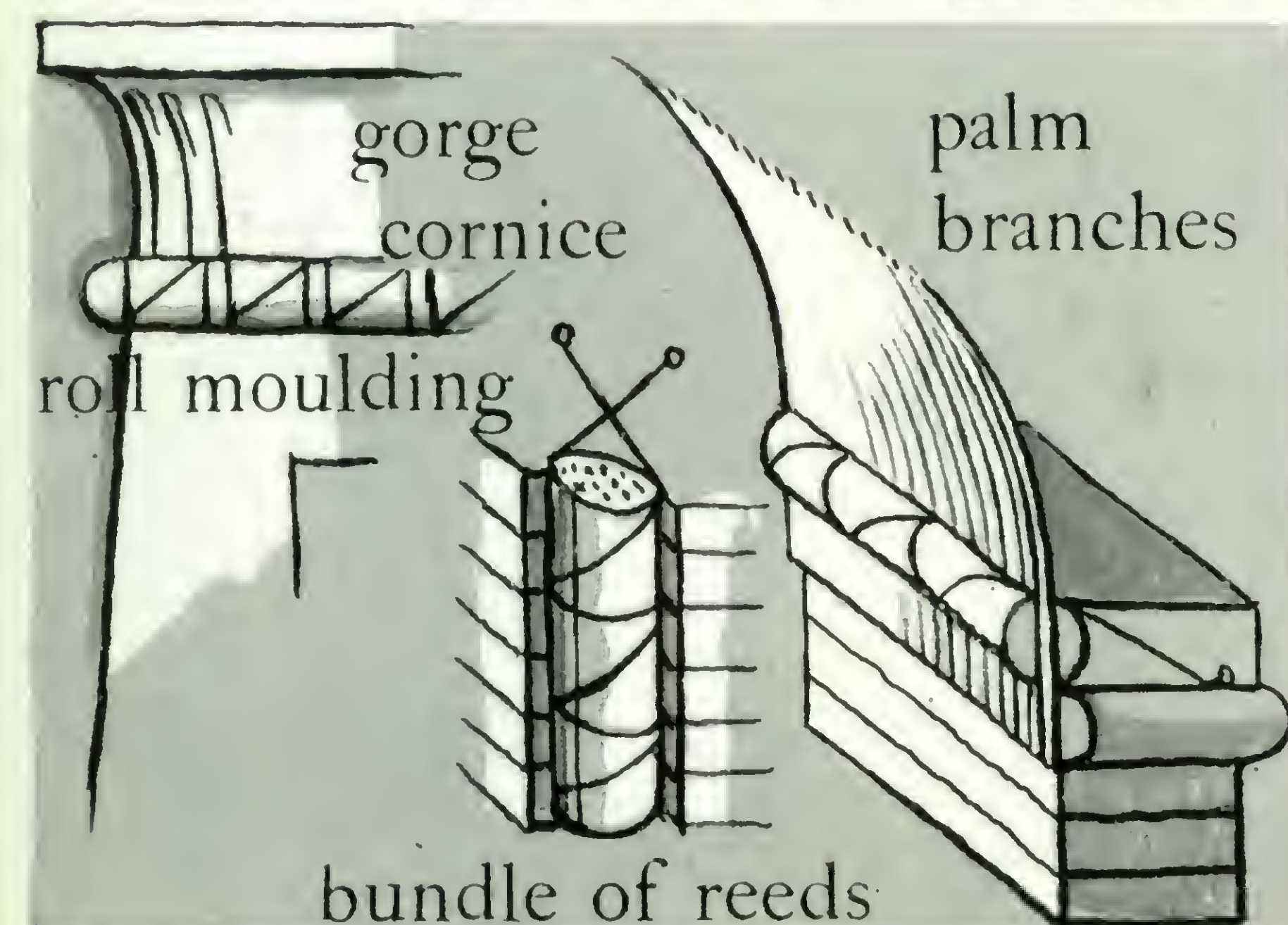


Temple of Isis,  
Philae

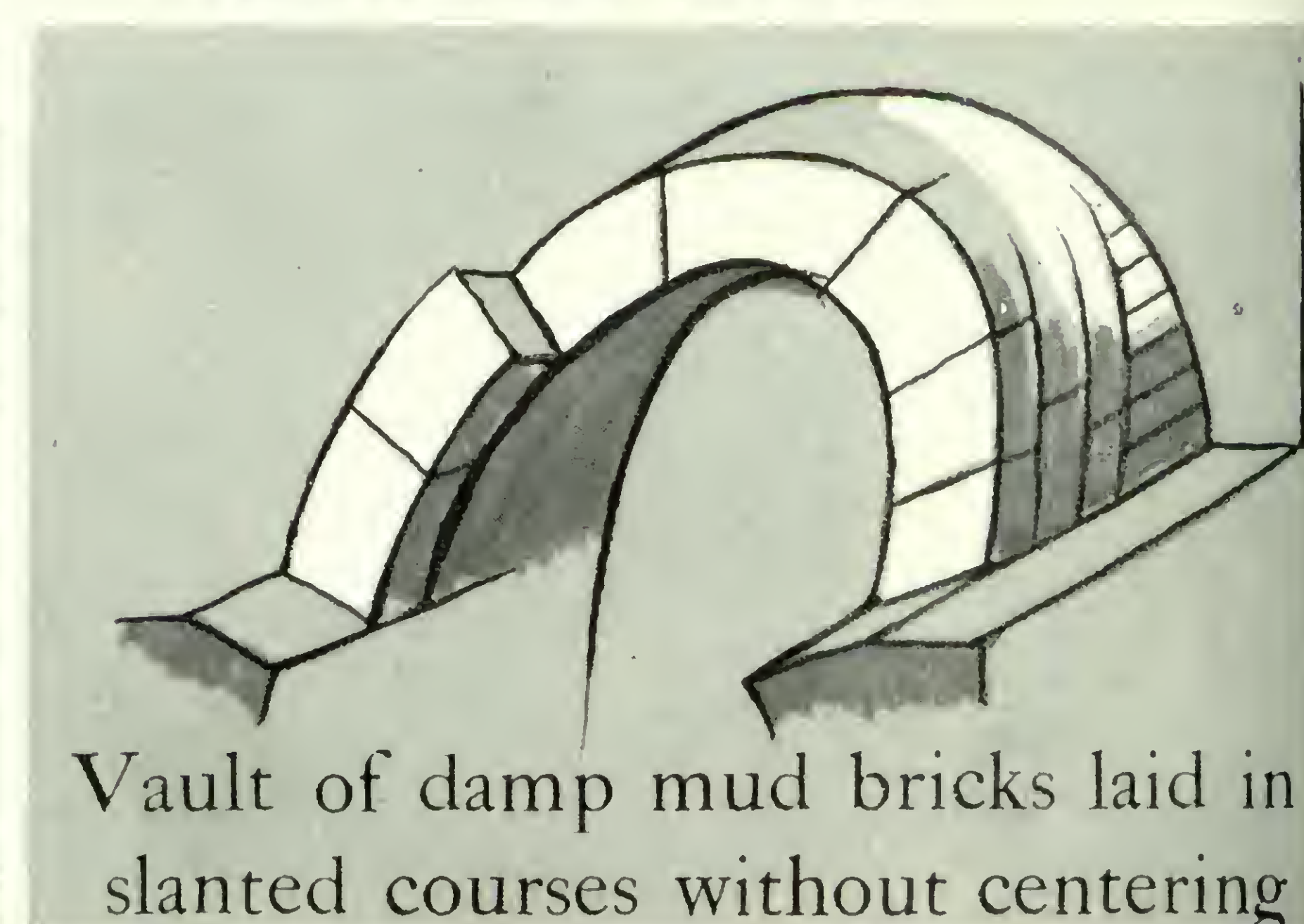
Ptolemaic

## LOTUS COLUMNS

## PALM COLUMNS



Brick arch,  
el 'Asaseef, Thebes



Vault of damp mud bricks laid in  
slanted courses without centering



# COLUMN BEAM & ARCH

Mortuary Chapel of Ne-user-ra, Abusir

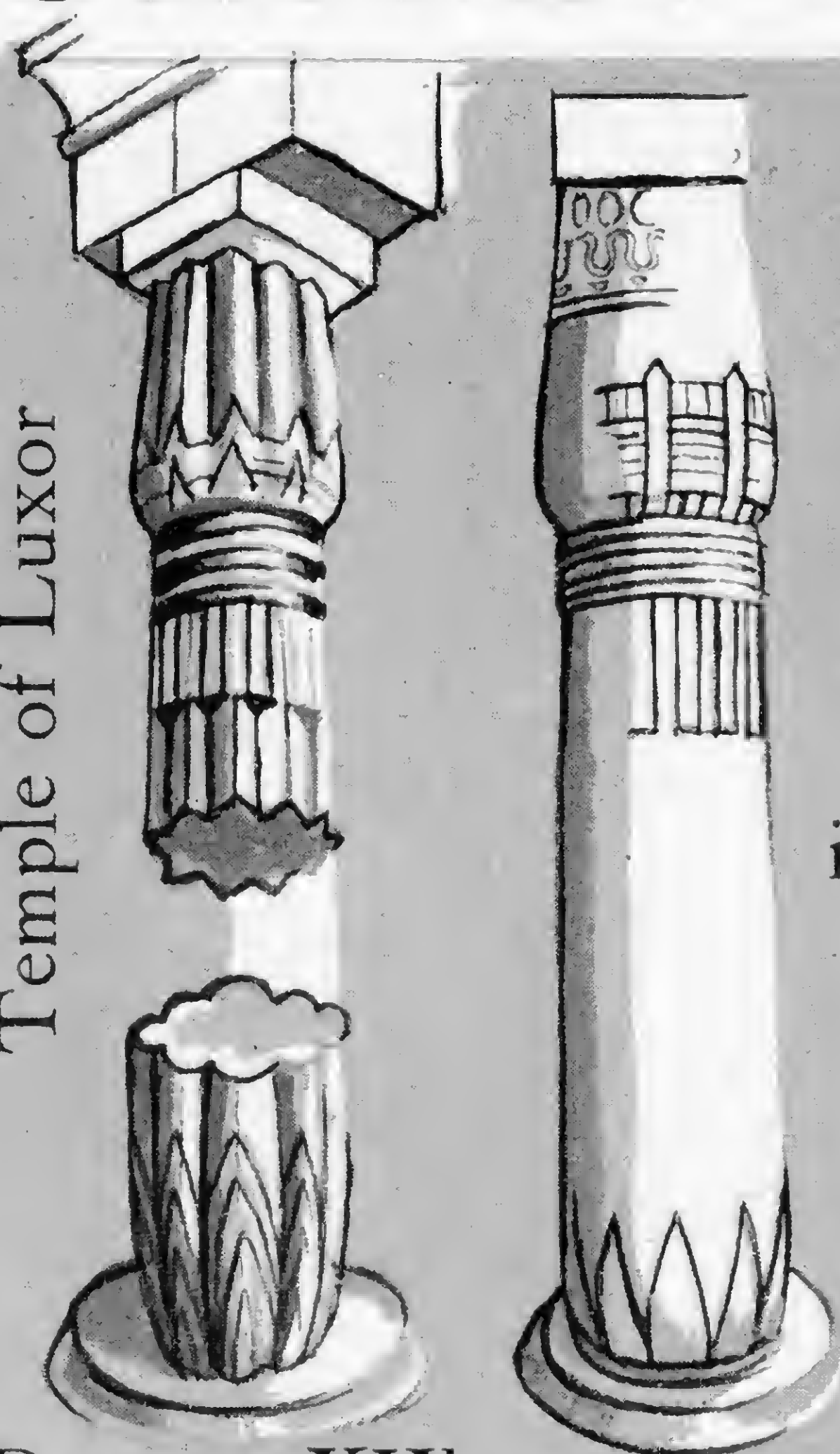


Dynasty V



Temple of Luxor

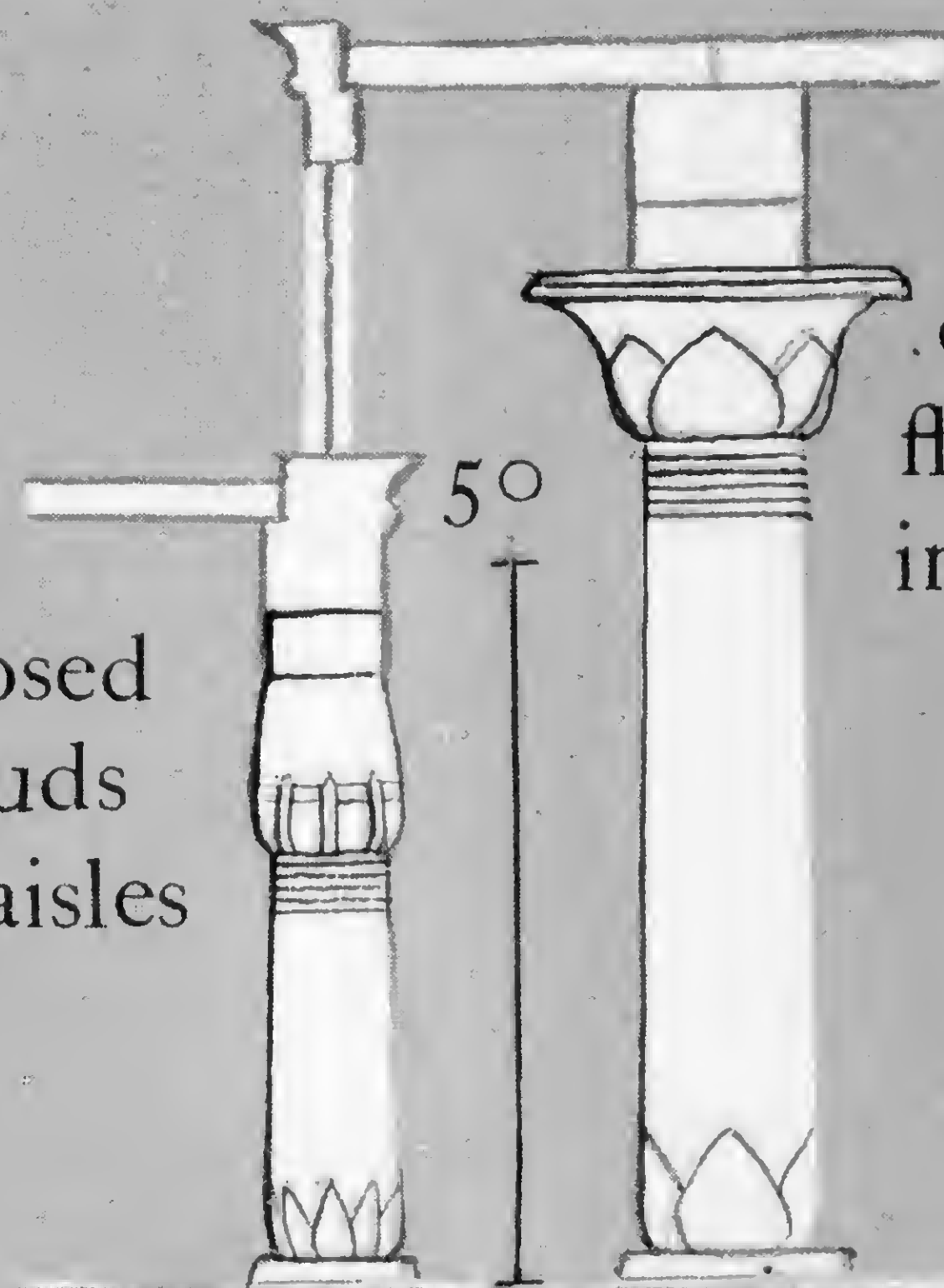
Dynasty XIX



closed  
buds  
in aisles

The Great Temple of Amon,  
Karnak; Hypostyle Hall,

Dynasty XIX



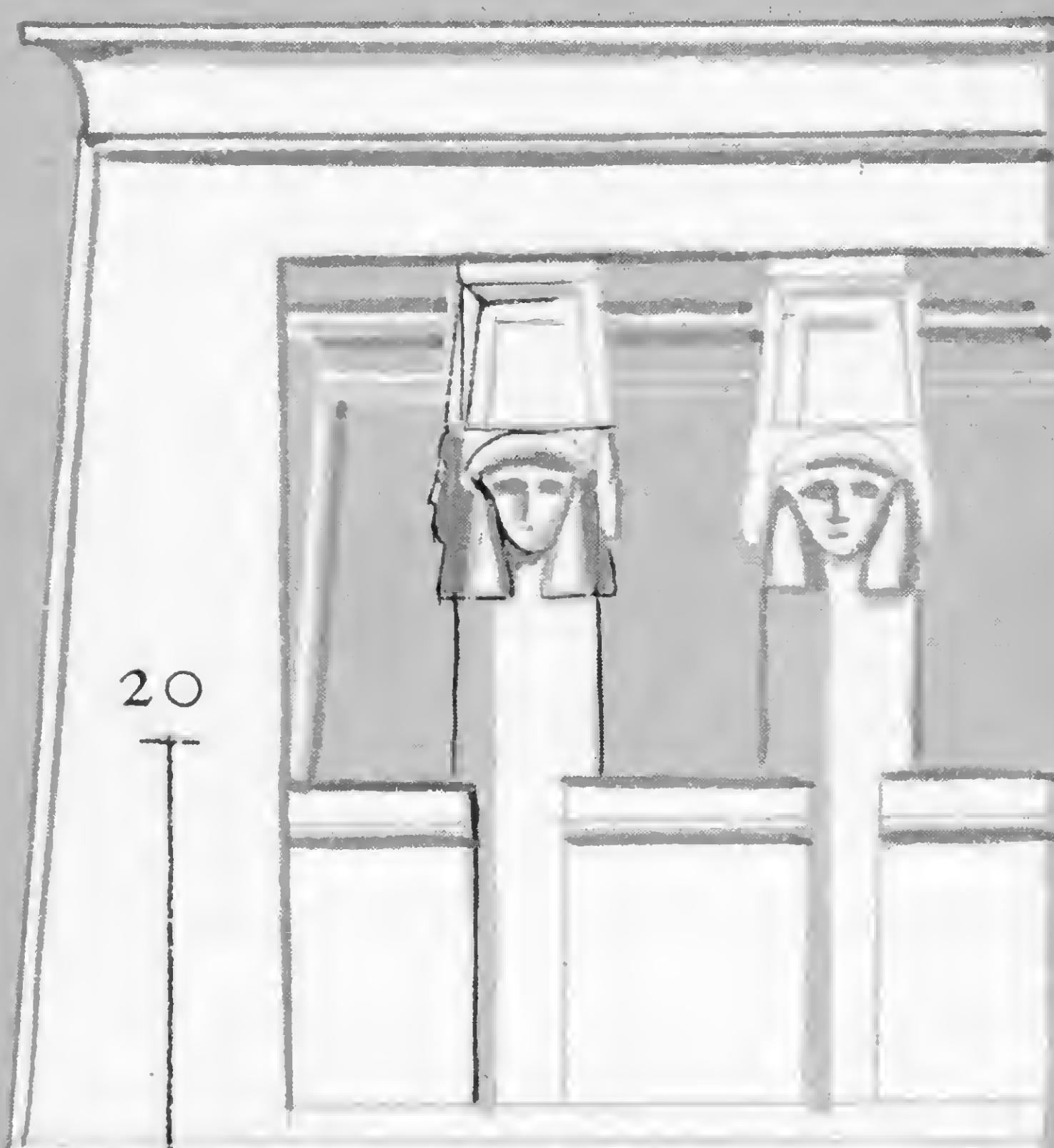
open  
flowers  
in nave



## PAPYRUS COLUMNS



Temple of Hathor, Denderah,  
Ptolemaic



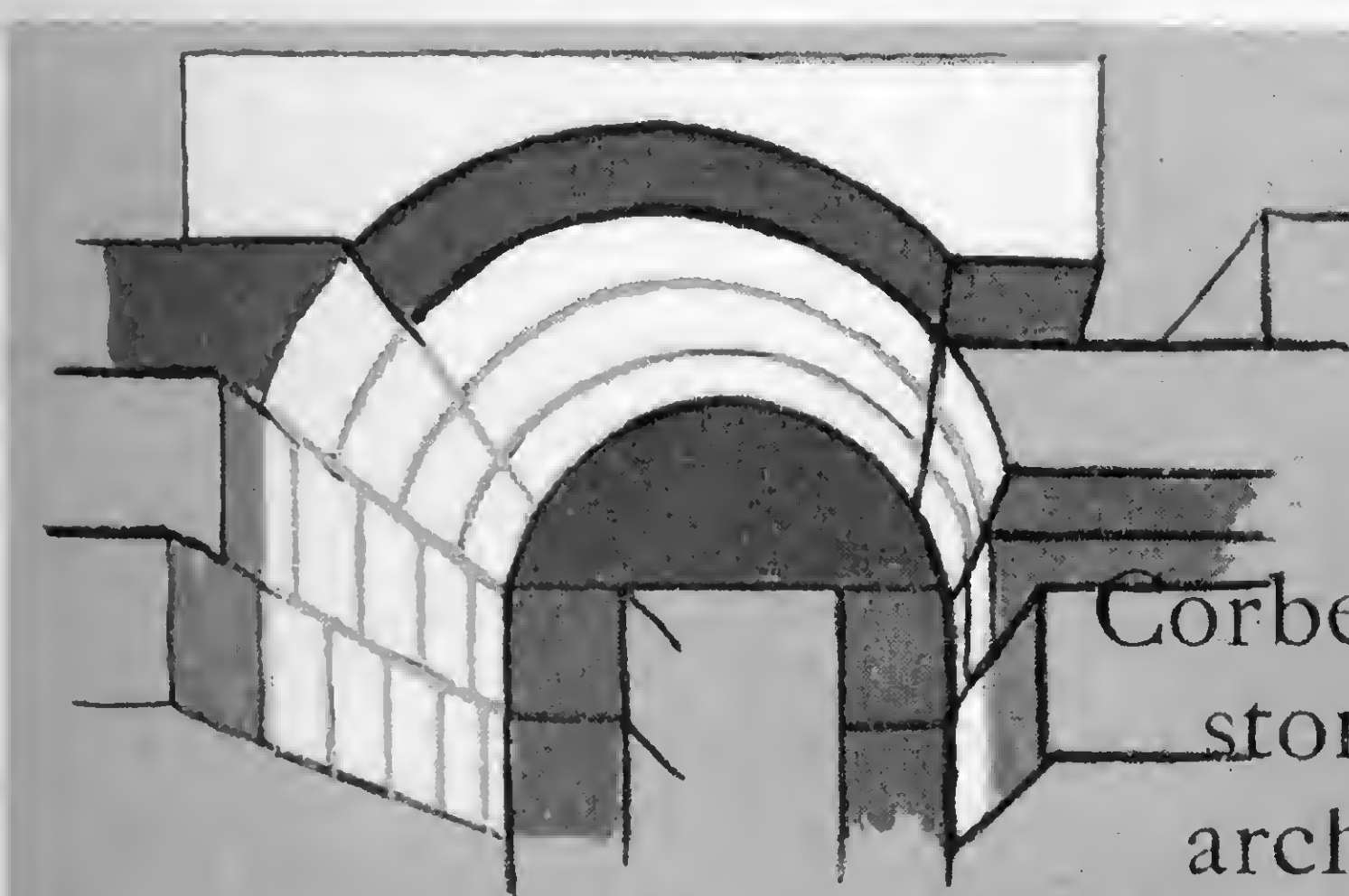
Temple of Isis,  
Philae



Ptolemaic

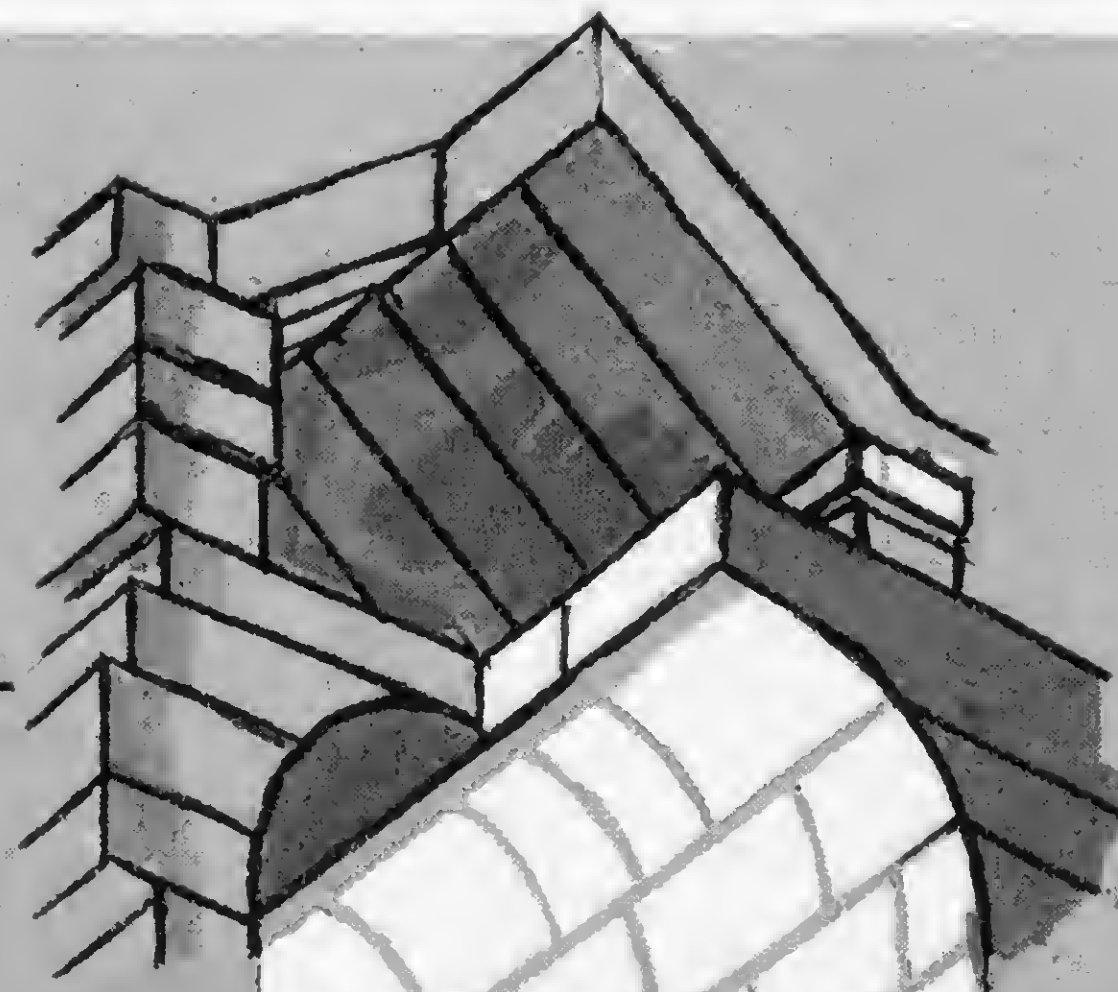
## HATHOR-HEADED COLUMNS

## COMPOSITE



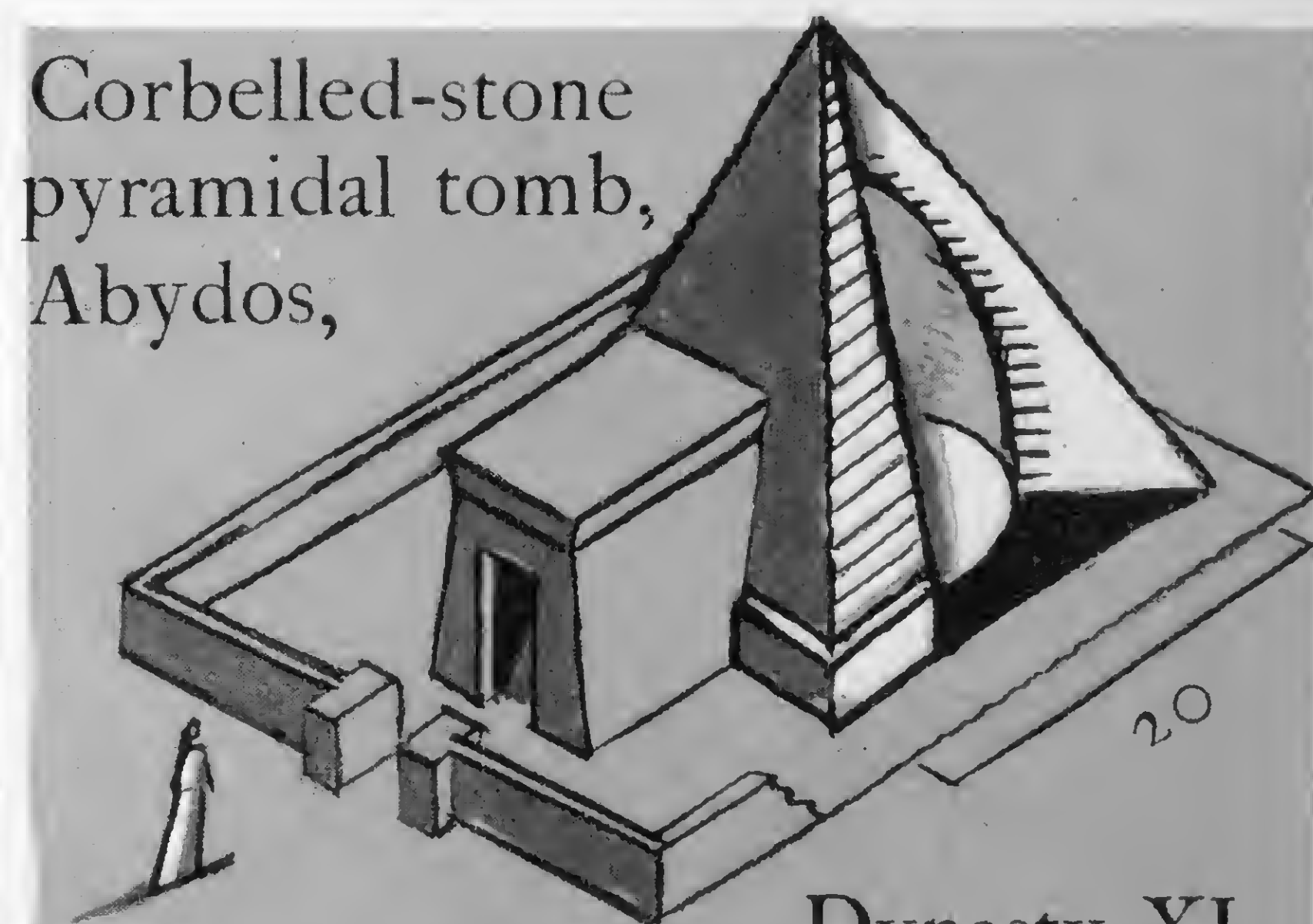
Corbelled-  
stone  
arches,

Temple-tomb Deir-el-Bahari



Temple of Seti I, Abydos

Dynasty XIX

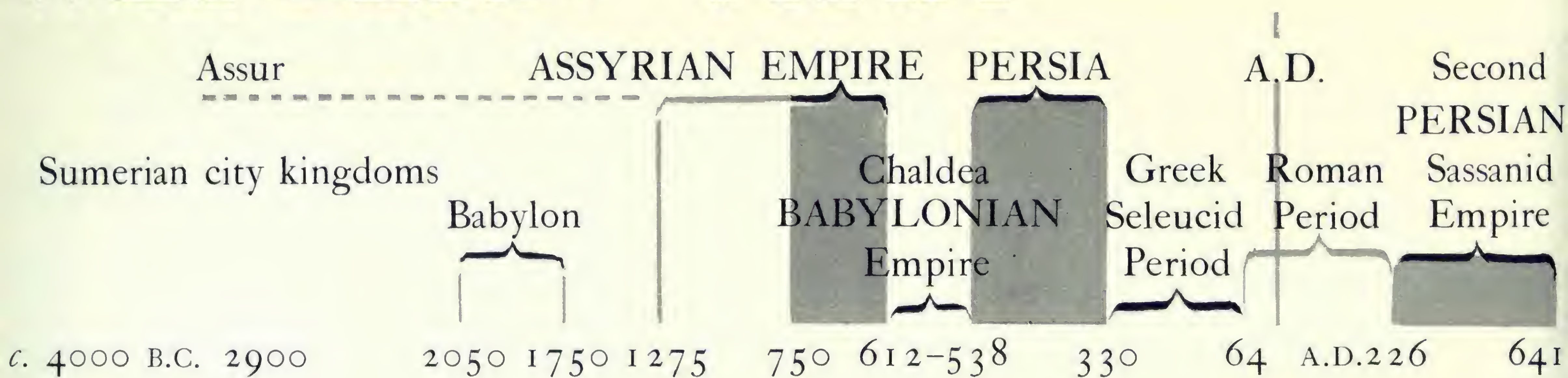


Corbelled-stone  
pyramidal tomb,  
Abydos,

Dynasty XI



# WESTERN ASIA



## SUMERIAN CITY KINGDOMS

Civilization in Western Asia began with city kingdoms in the rich alluvial plain between the lower Tigris and the Euphrates, an area about that of Wales (Map p. 14). Tower-temples or ziggurats were the centre of city life. There was no stone and little timber but clay was moulded into sun-dried brick. Buildings were faced with kiln-baked bricks, sparingly owing to lack of fuel.

### ASSYRIA

Assyria was set on a high tableland of lime-stone, harder rock & alabaster, but the Assyrians continued to use sun-dried and kiln-baked bricks. Palaces of warrior-kings were built on large platforms of brick 30-50 feet high. Lower courses of walls were faced with slabs of alabaster 9-12 feet high and carved with bas-reliefs or covered with plaster and painted with bright colour. The arch was constructed for gateways, vaults and drains.

### SECOND BABYLONIAN EMPIRE

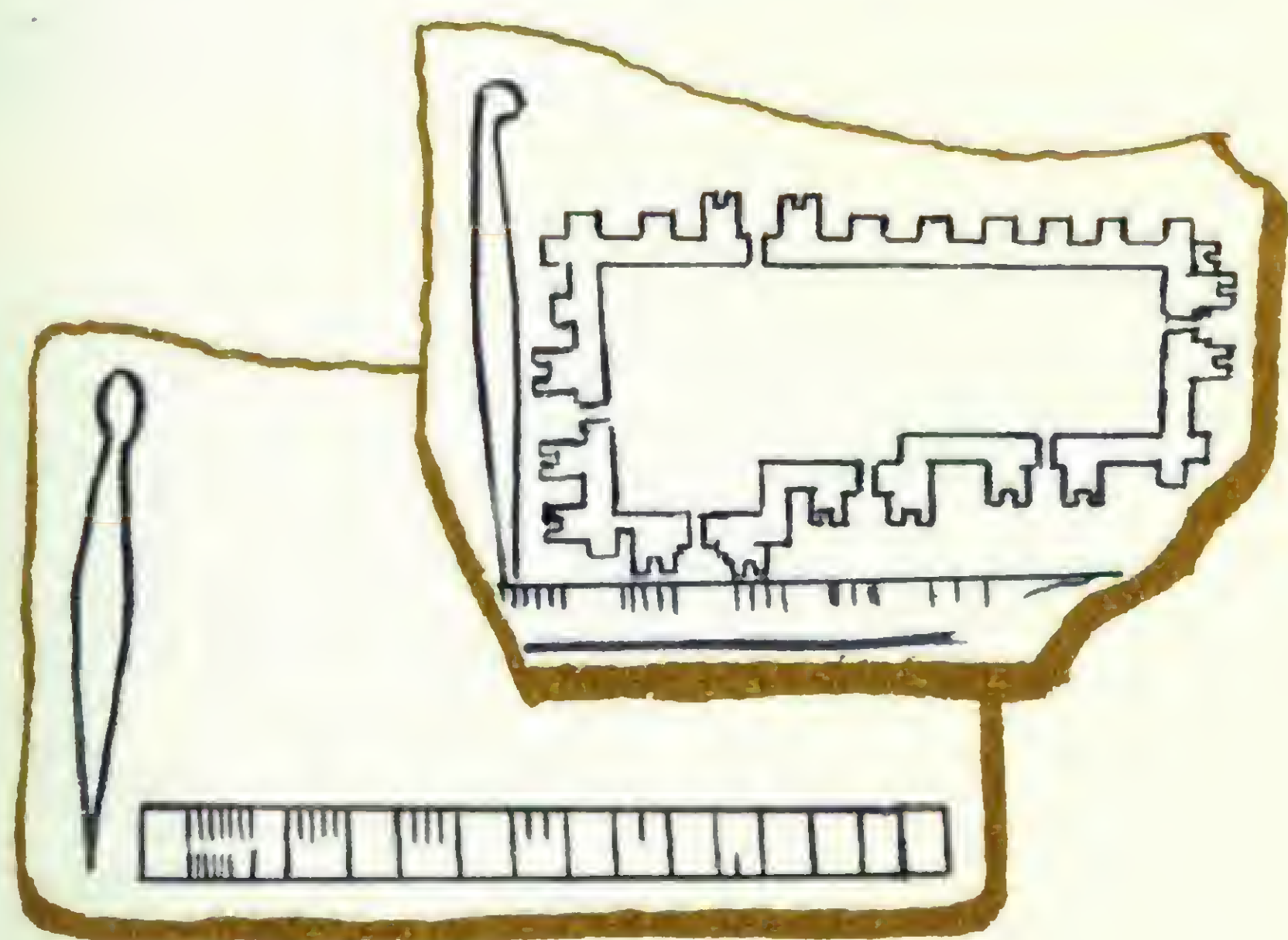
Nebuchadnezzar (604-561 B.C.) rebuilt Babylon to a regular plan described in *The Histories* by Herodotus (484-406 B.C.). Buildings were of kiln-baked brick and bitumen.

### PERSIAN EMPIRE

Palaces were built at the capital city of Susa, at Pasargadae and Persepolis, being constructed of stone which was abundant in Persia; whilst raised platforms and glazed coloured bricks were adapted from the Assyrians; also influences from Babylon, Syria and Egypt.

### SECOND PERSIAN—SASSANID—EMPIRE

The capital city at Ctesiphon. Buildings were erected of kiln-baked brick, vaults and the earliest domes being built over square compartments, developed by the Byzantines.



Stilus, scale and plan of King Gudea of Lagash, c. 2350 B.C.



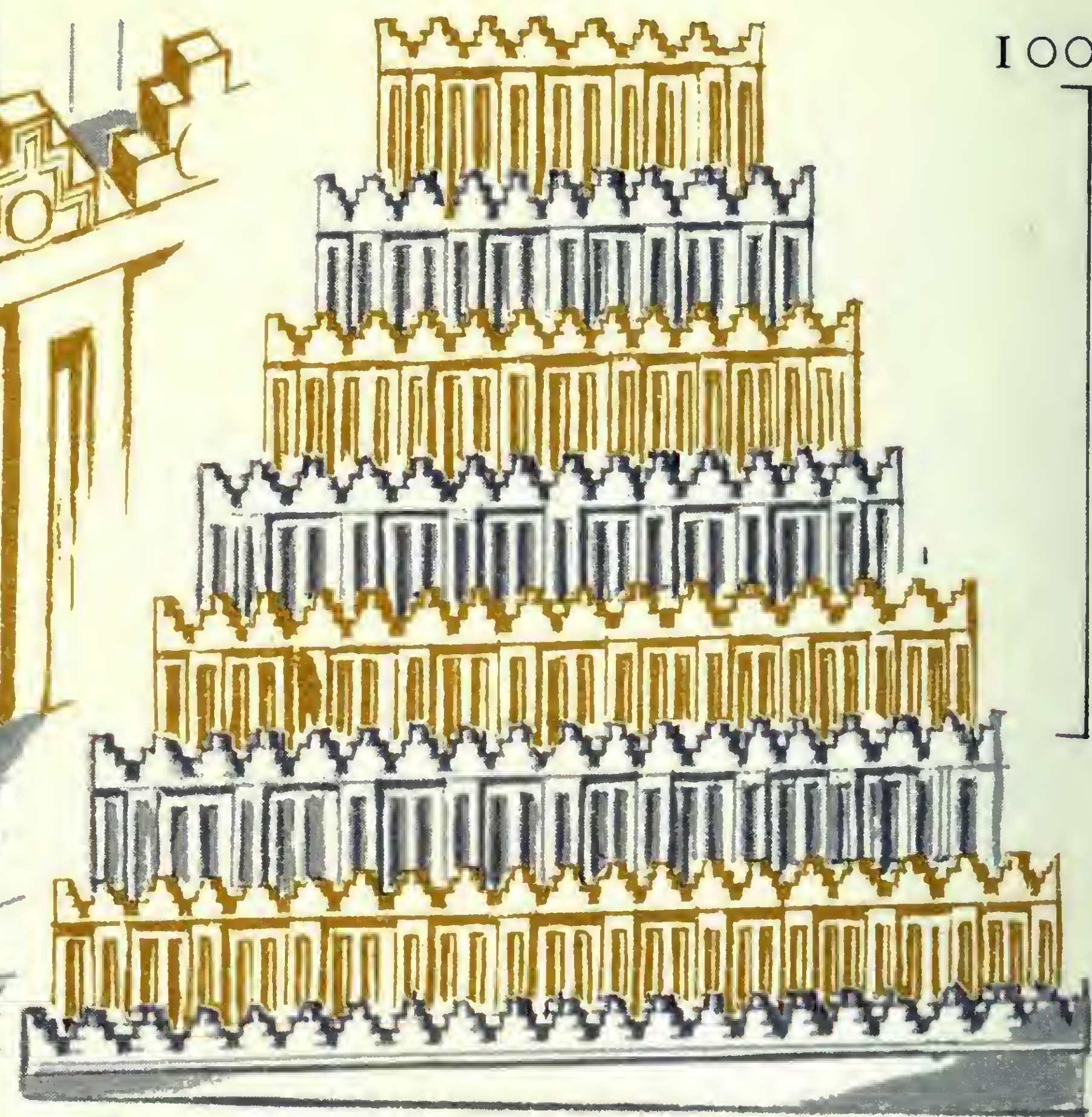
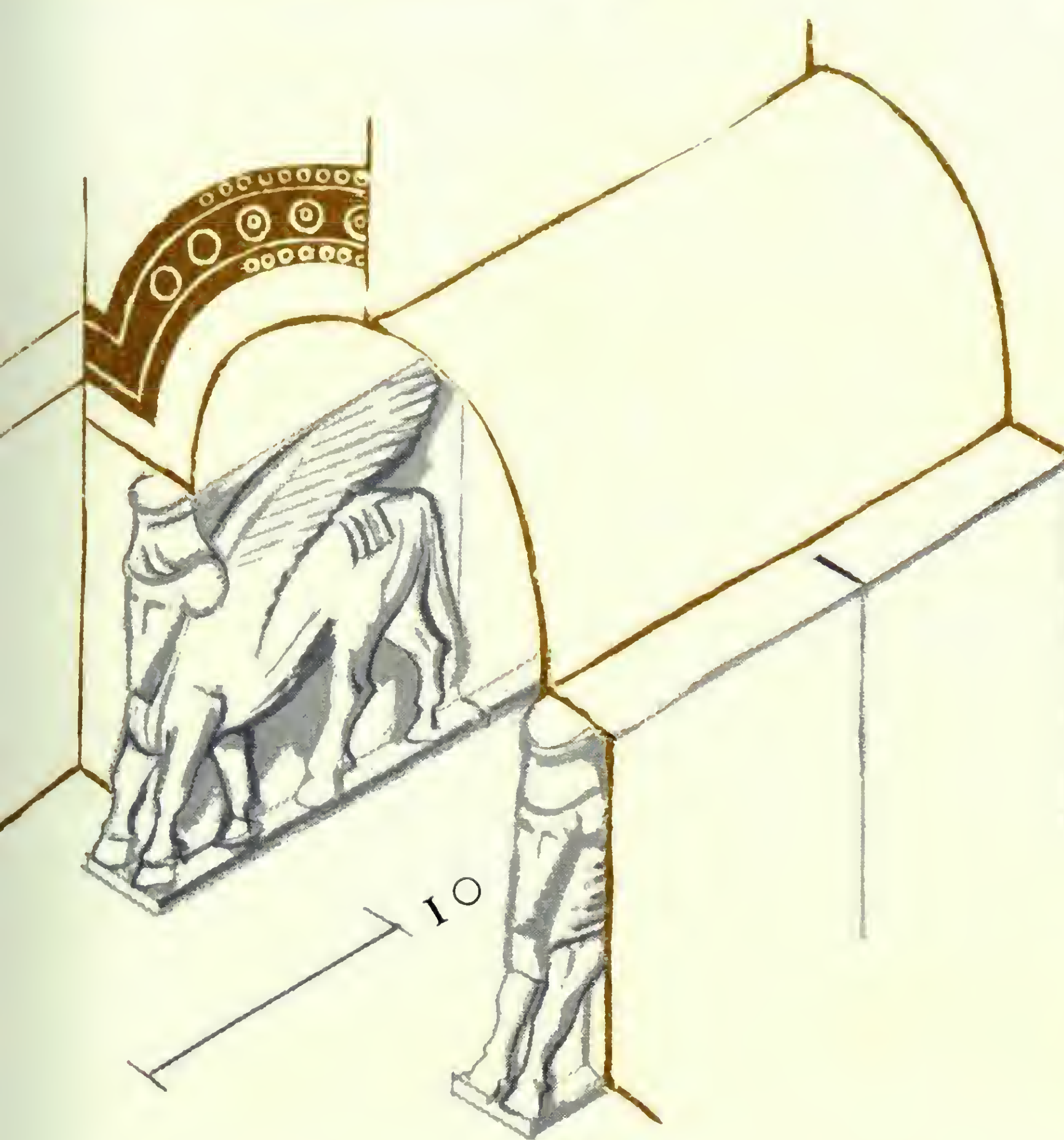
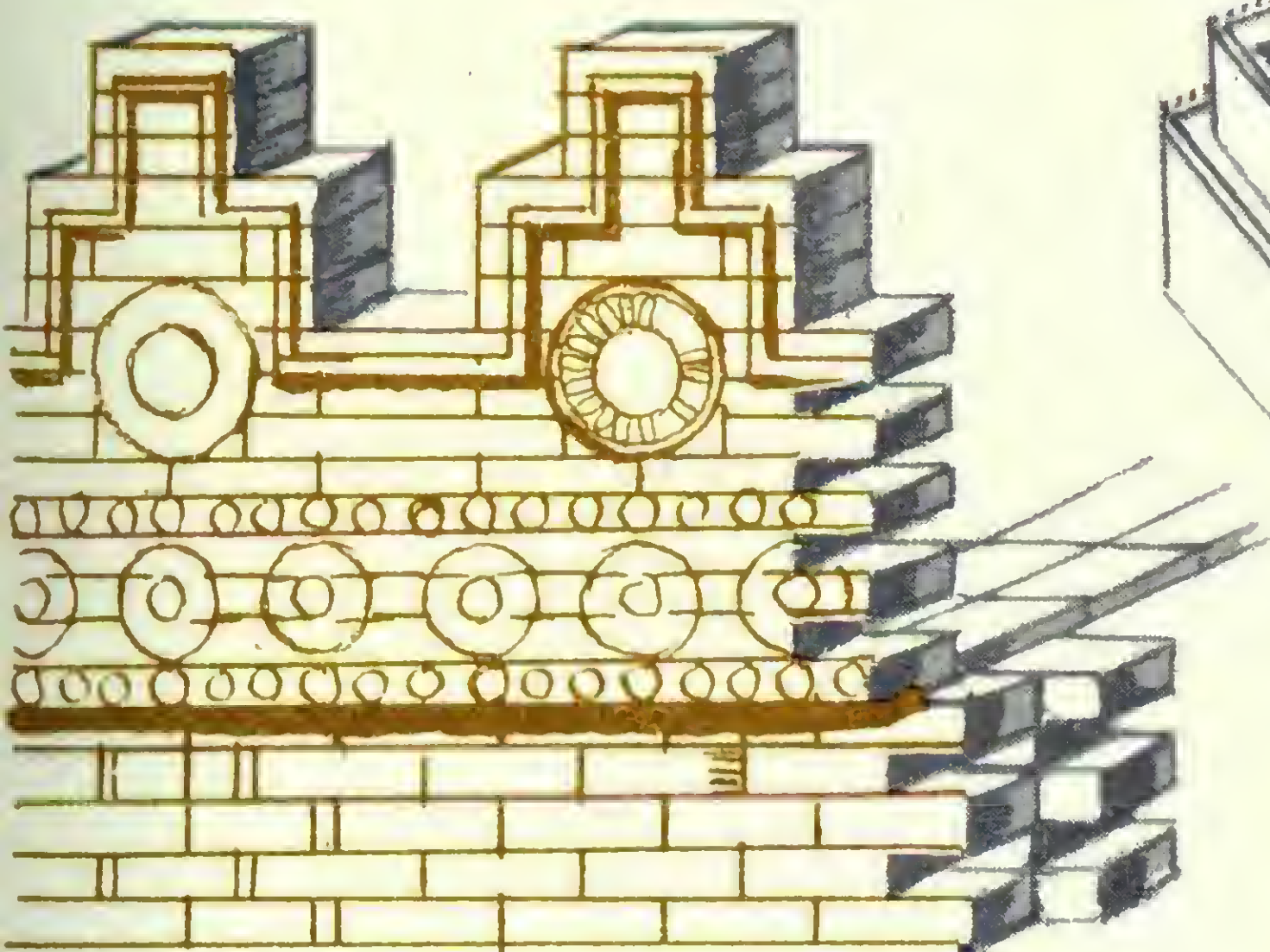
The Ziggurat, Ur (restored), c. 2350 B.C.



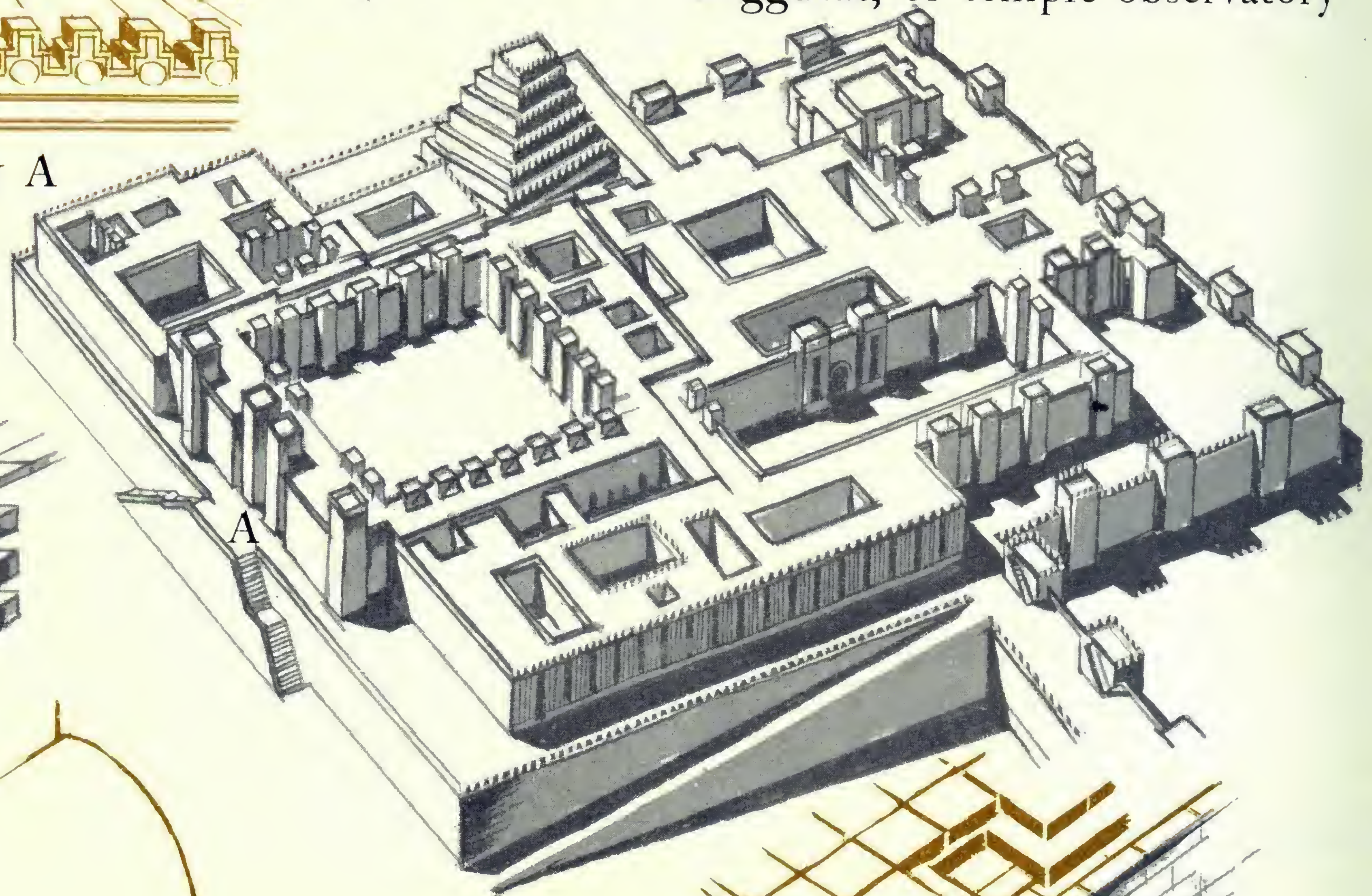
# INTRODUCTION - ASSYRIA



South-east gateway A



Ziggurat, or temple observatory

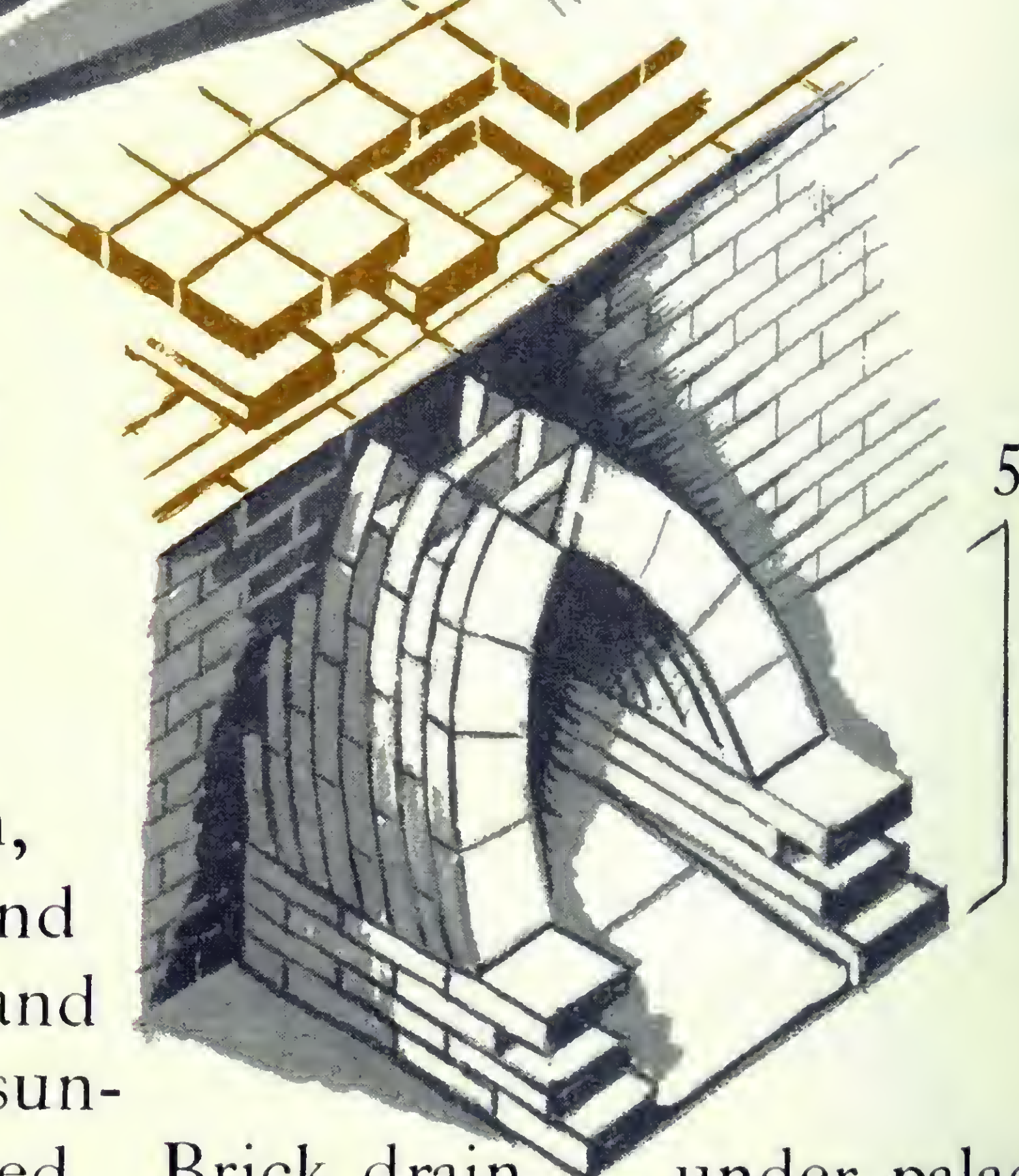


## PALACE OF SAGON II KHORSABAD

(restored)

772-705 B.C.

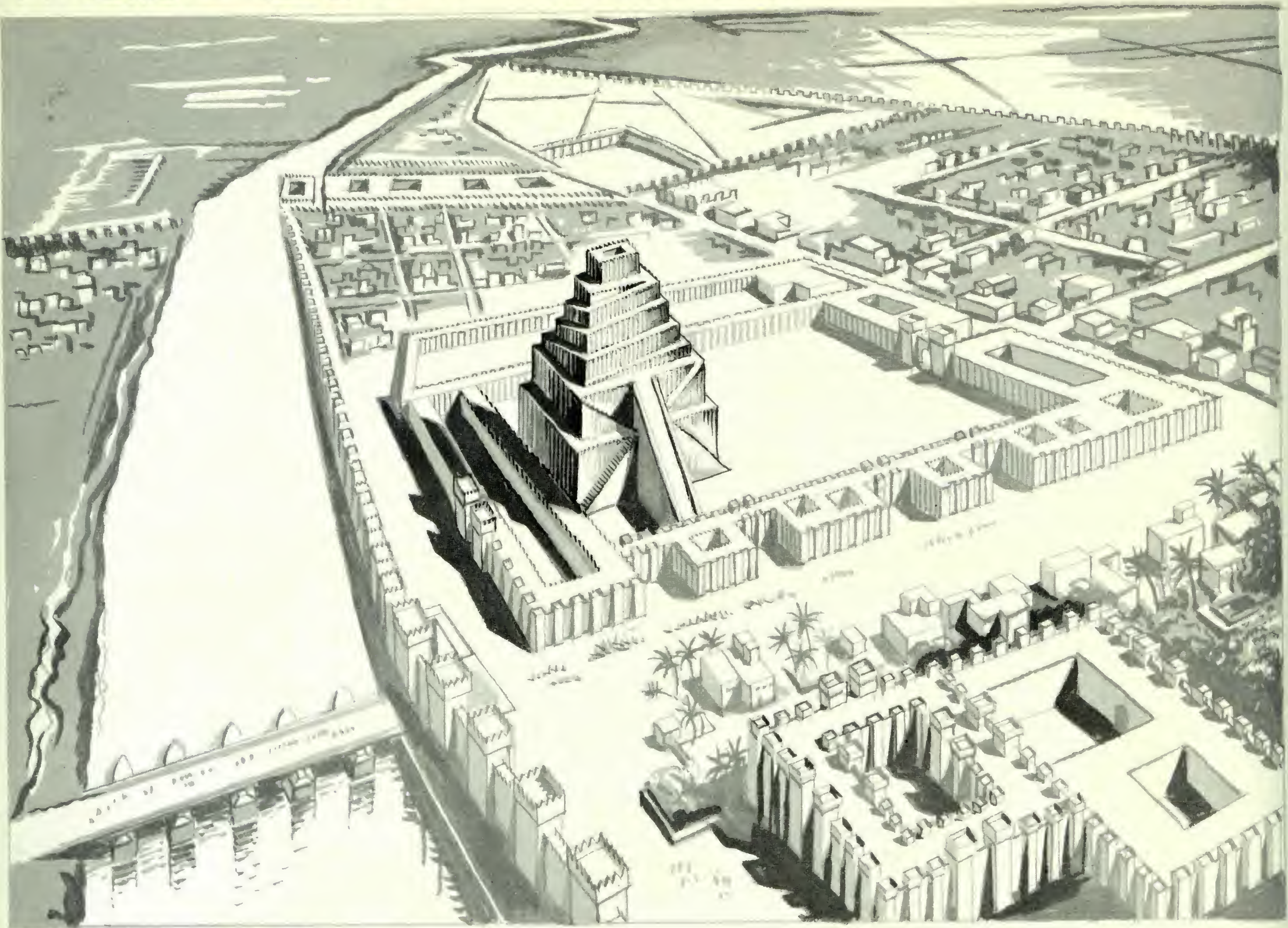
Both the platform,  
about 50 ft high and  
25 acres in extent, and  
the palace built of sun-  
dried brick and faced  
with kiln-baked brick



Brick drain under palace  
built without centering



# WESTERN ASIA BABYLON



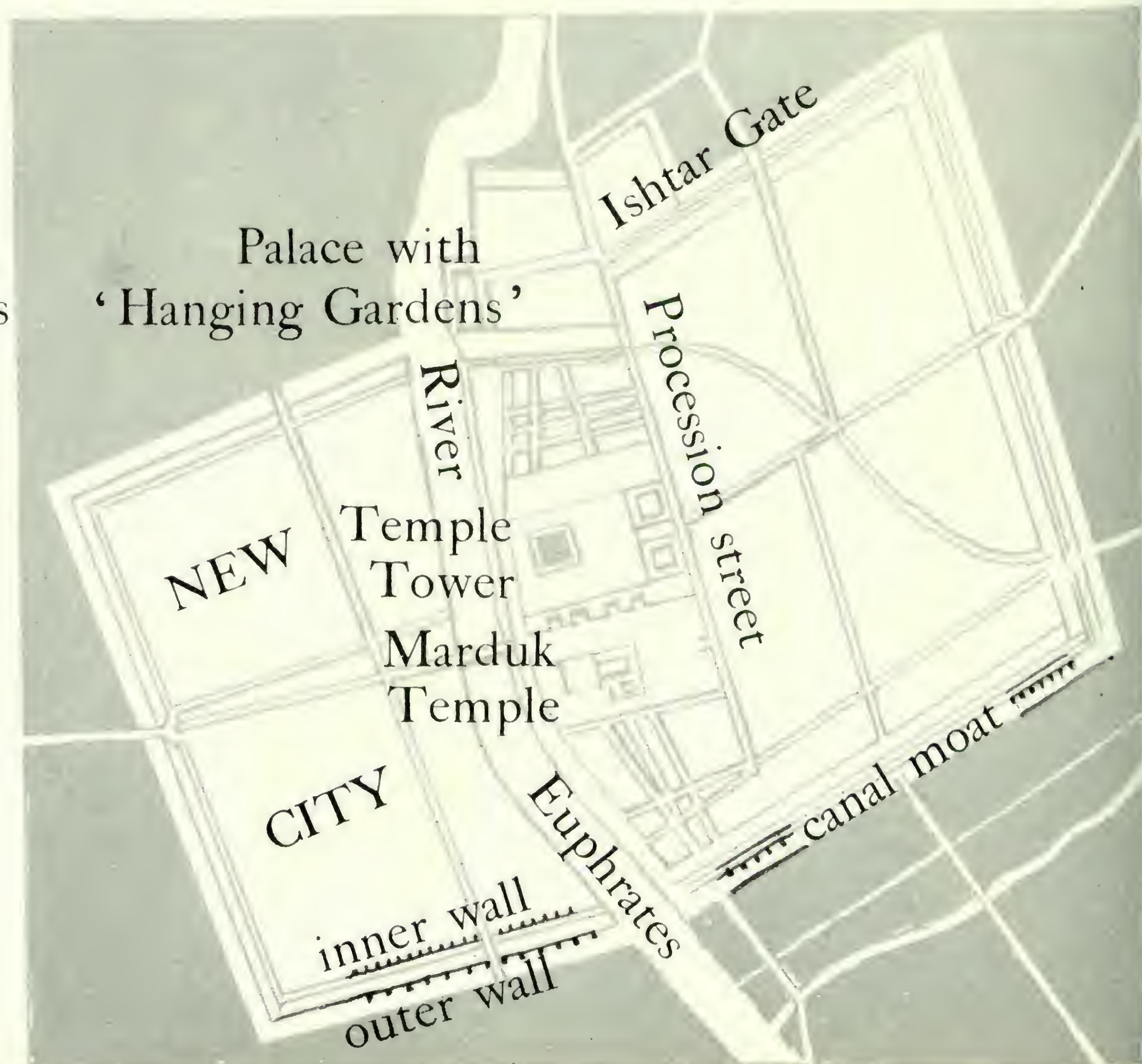
## THE CITY OF BABYLON (reconstructed),

as rebuilt by Nebuchadnezzar,  
604-561 B.C., during the Second  
Babylonian Empire.

Described in *The Histories* of Herodotus



House with roof-garden





Hall of 100 columns, Darius

Palace of Xerxes

Palace of Darius

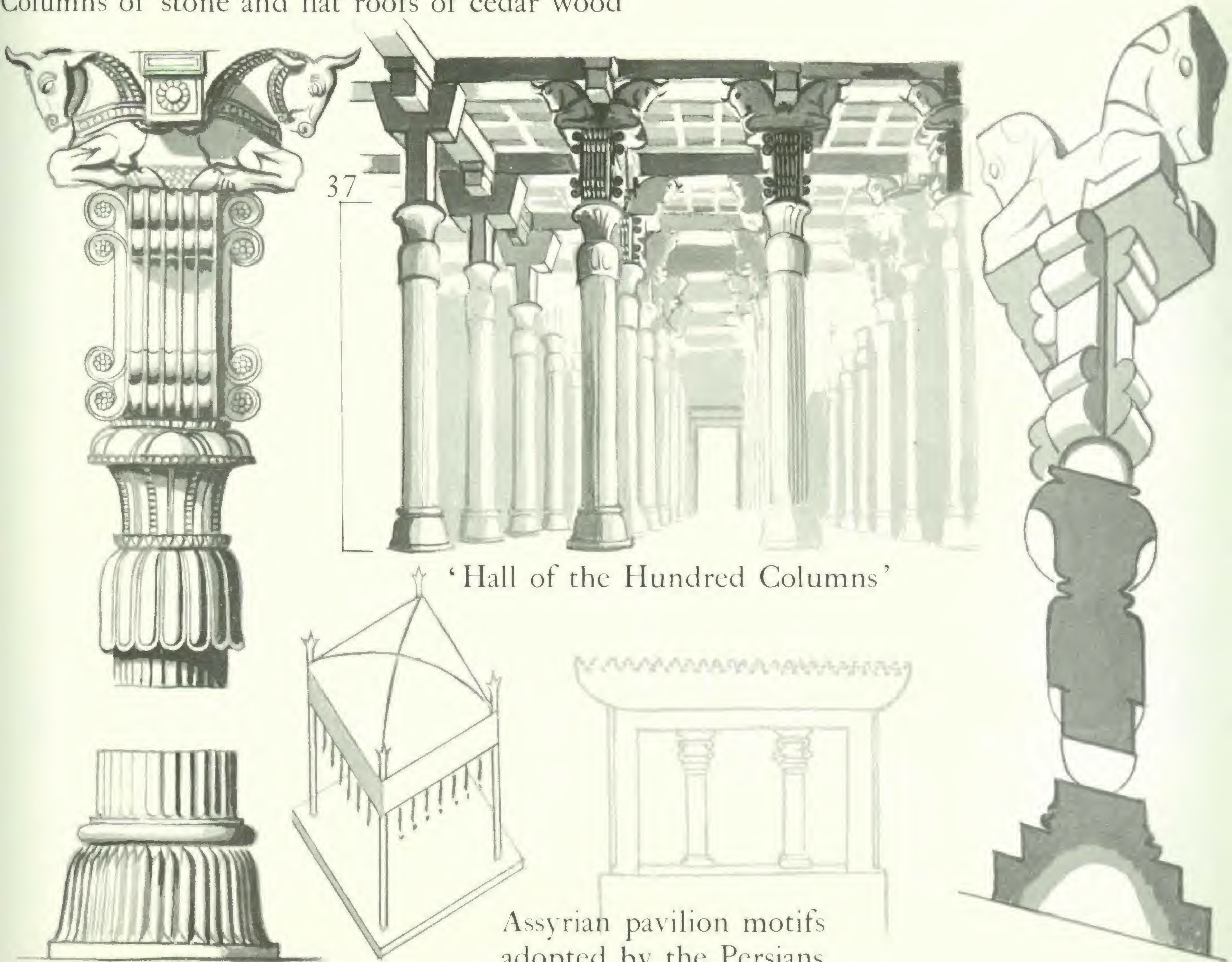
Hypostyle

Hall of Xerxes

Propylae of Xerxes

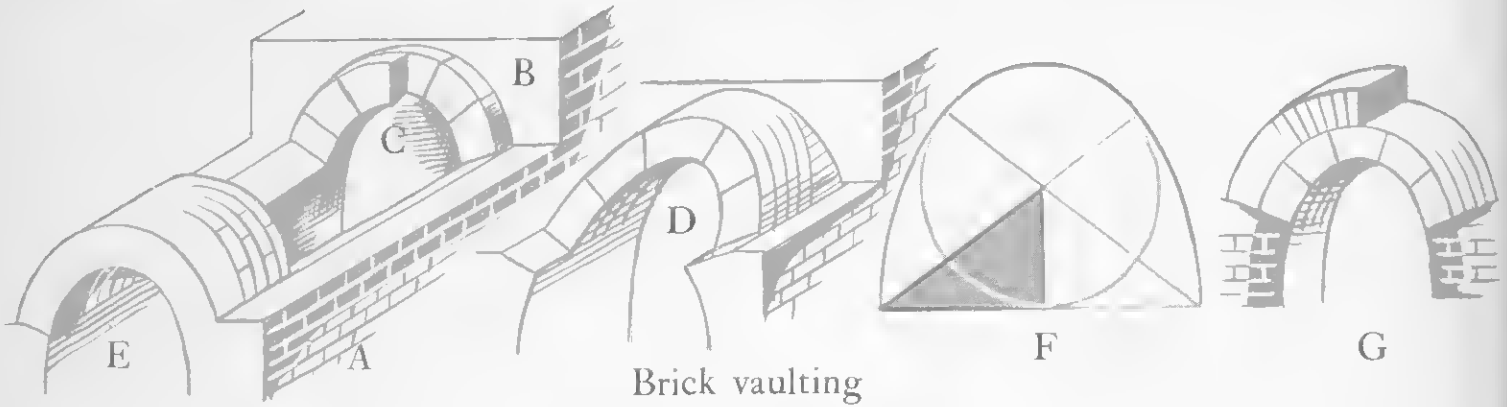
## THE PALACES OF PERSEPOLIS (reconstructed),

Built by Darius (521-485 B.C.) and Xerxes (485-465 B.C.)  
Built on a platform 1500 ft by 1000 ft in area, and 40 ft above the plain, part solid rock, part large blocks of stone, without mortar, held by metal cramps. Buildings constructed of sun-dried brick and faced with glazed bricks. Columns of stone and flat roofs of cedar wood

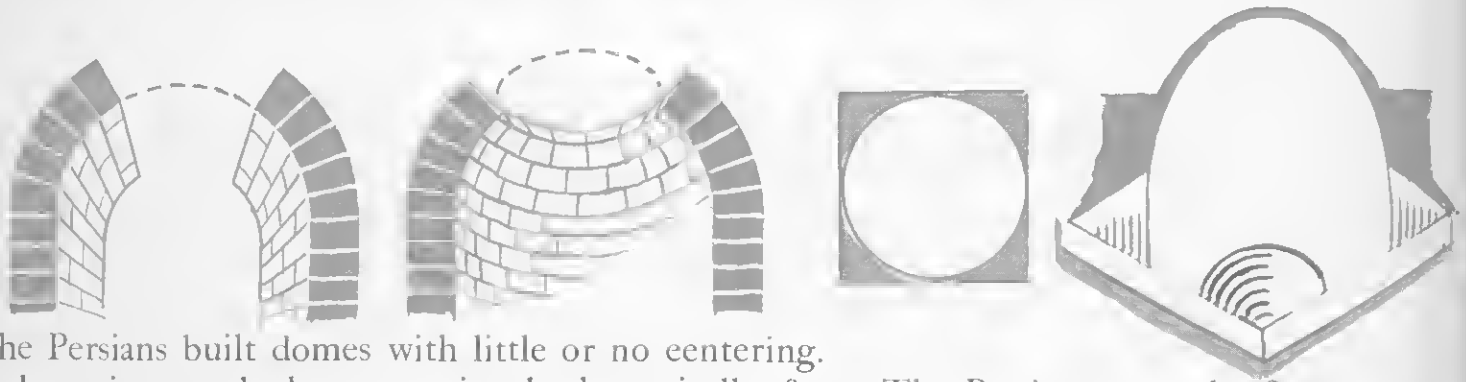




# WESTERN ASIA VAULTS &

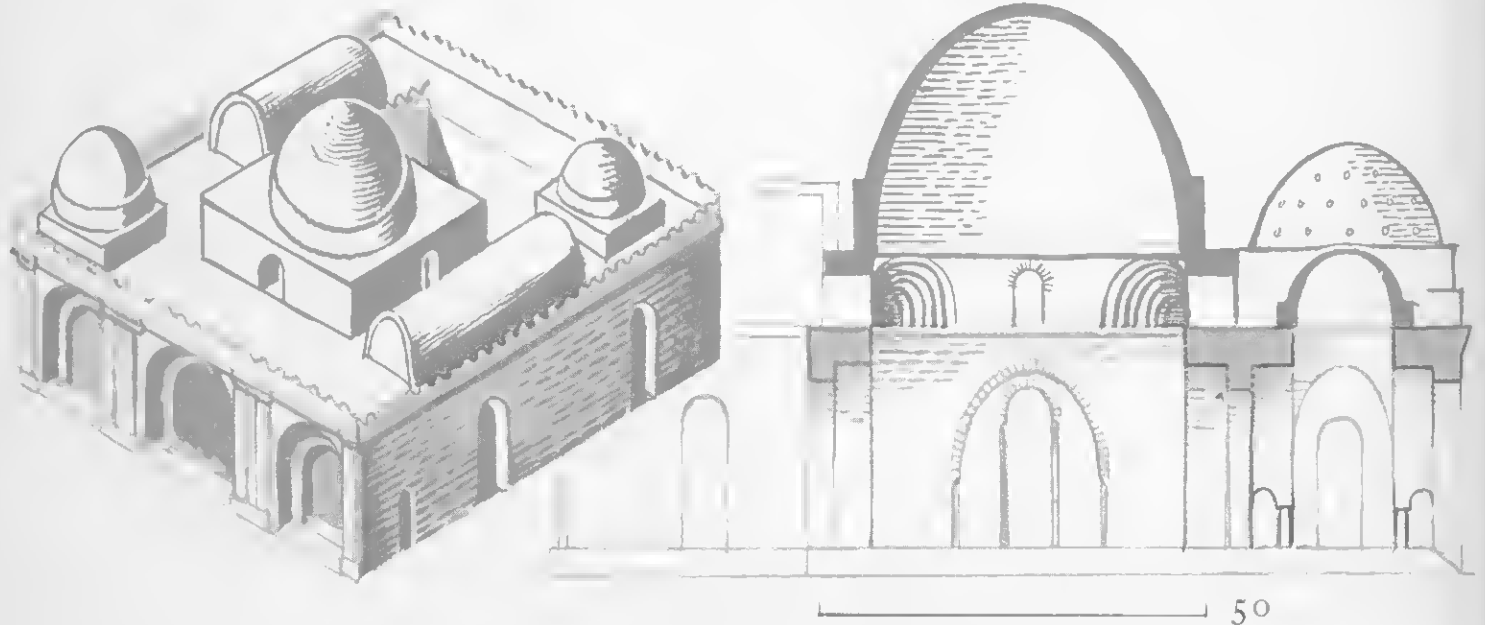


Bricks were laid to form a base A; against an end wall B wedge-shaped bricks were fixed with mortar C. To ensure adherence these were often laid in sloping courses D. An arch was constructed with little or no centering to complete the vault E. To facilitate work and to reduce pressure, vaults (and domes) had a high oval profile F. When completed vaults were often re-inforced by a second or more courses of brick G. Sassanid Persian buildings, vaults and domes were constructed of kiln-baked bricks laid with a mortar of lime and sand



The Persians built domes with little or no centering. A dome is an arched construction both vertically & horizontally: each ring of brick or stone once closed in cannot fall if it rests adequately on the ring below

The Persians were the first to erect circular domes on square plans with four angular corbelled semi-domes

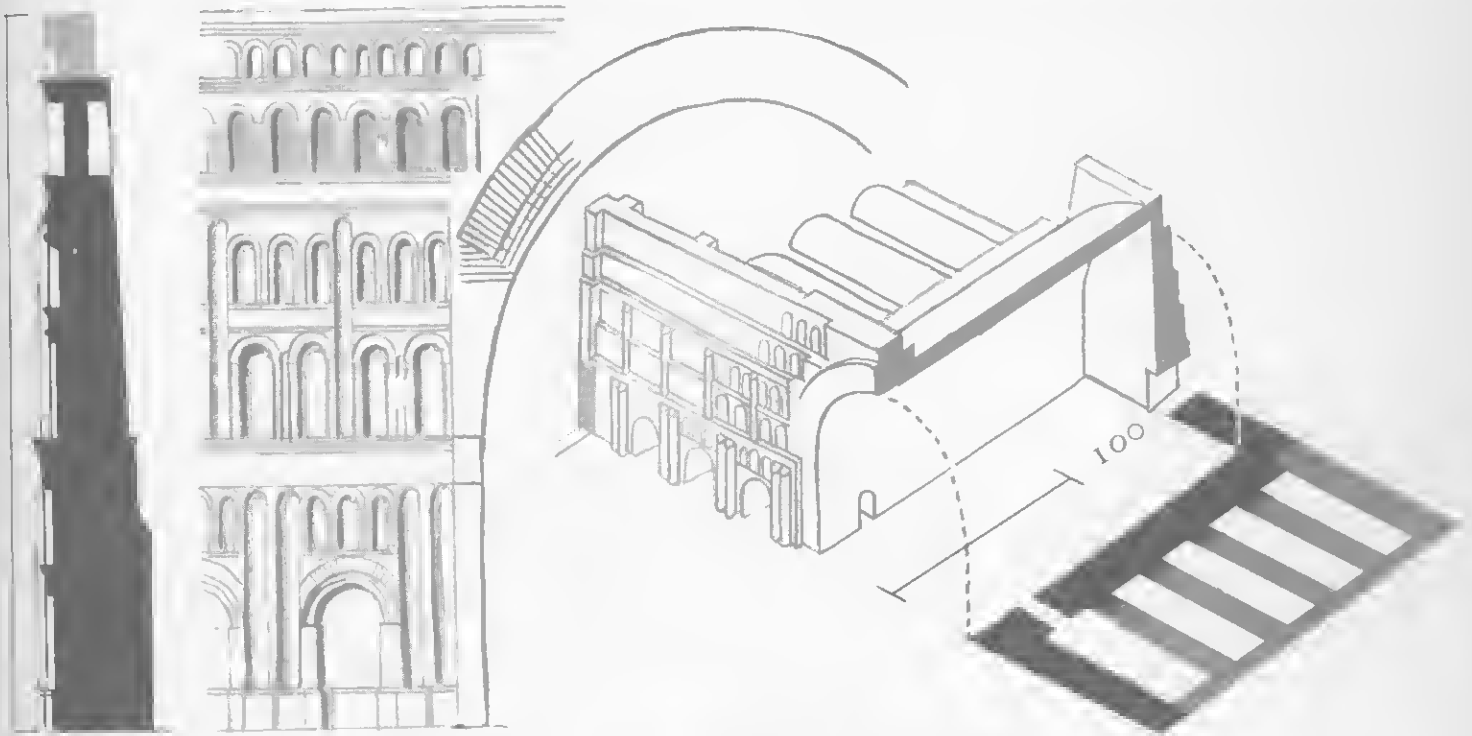


The Palace, Serbistan (exterior restored), c. A.D. 350

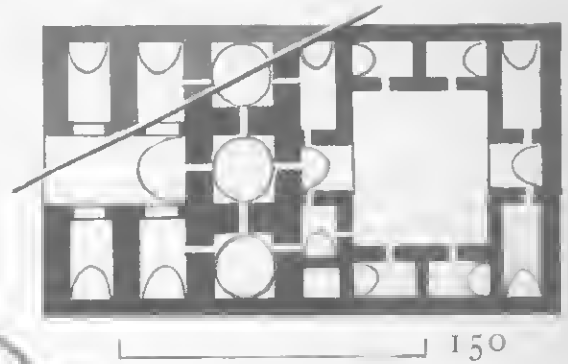


# DOMES - SECOND PERSIAN EMPIRE

112'5



The Palace of Chosroes, Ctesiphon, 6th cent. A.D.



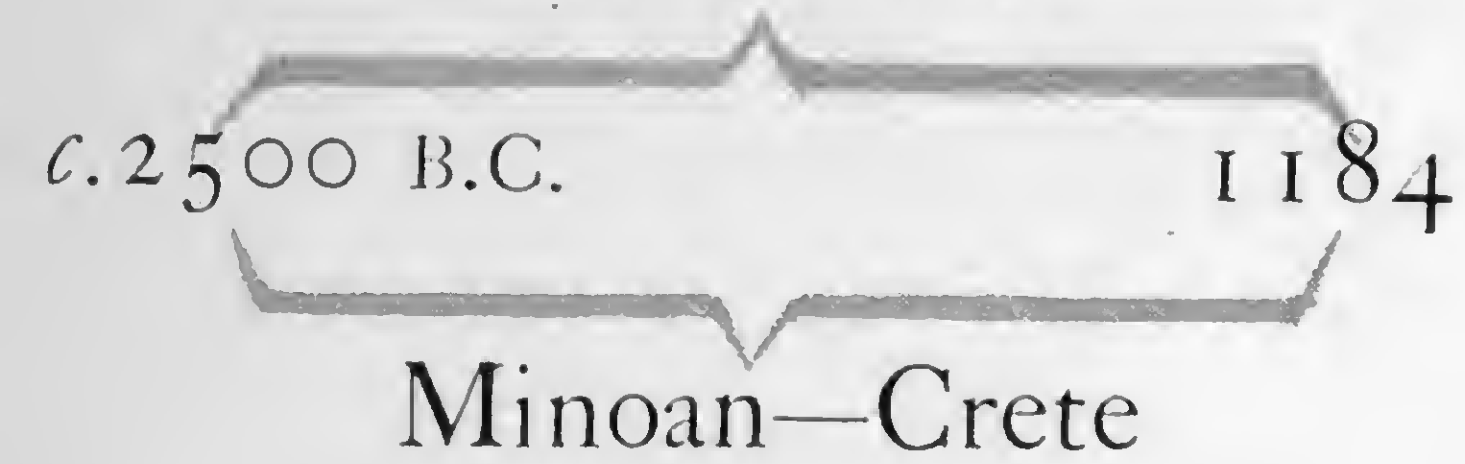
The Palace, Firouzabad (exterior restored), c. A.D. 450



# GREEK

AEGEAN

HELLENIC



775/6  
First  
Olympiad

650

500

Archaic period

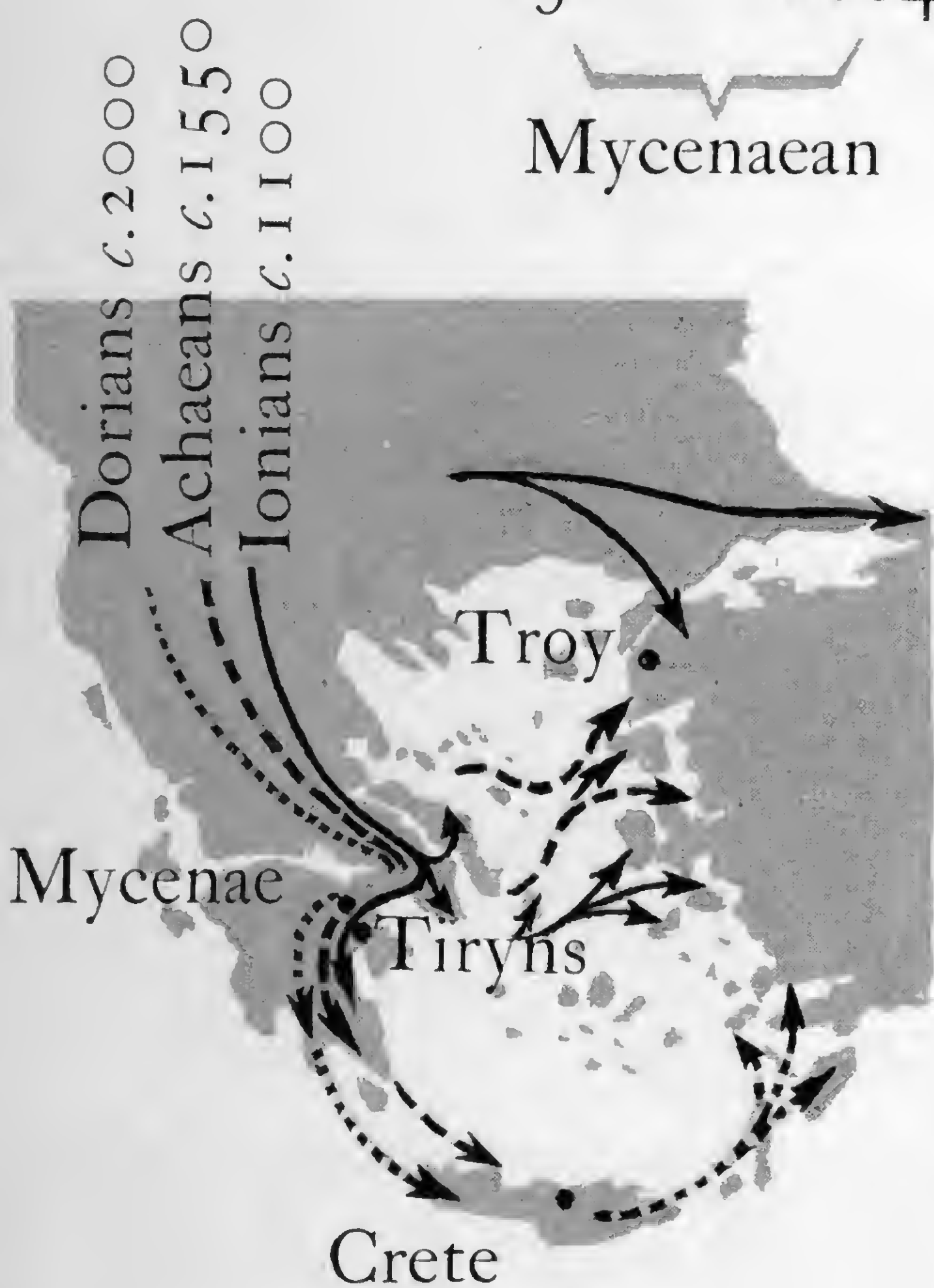
Establishment of Greek city-states  
along the Mediterranean and Black Sea

1500 1184

Mycenaean

c.835 Homer

c.582 Pythagoras c.510



The Greek invasions

Greek colonisation 8th-6th centuries B.C.



100 miles

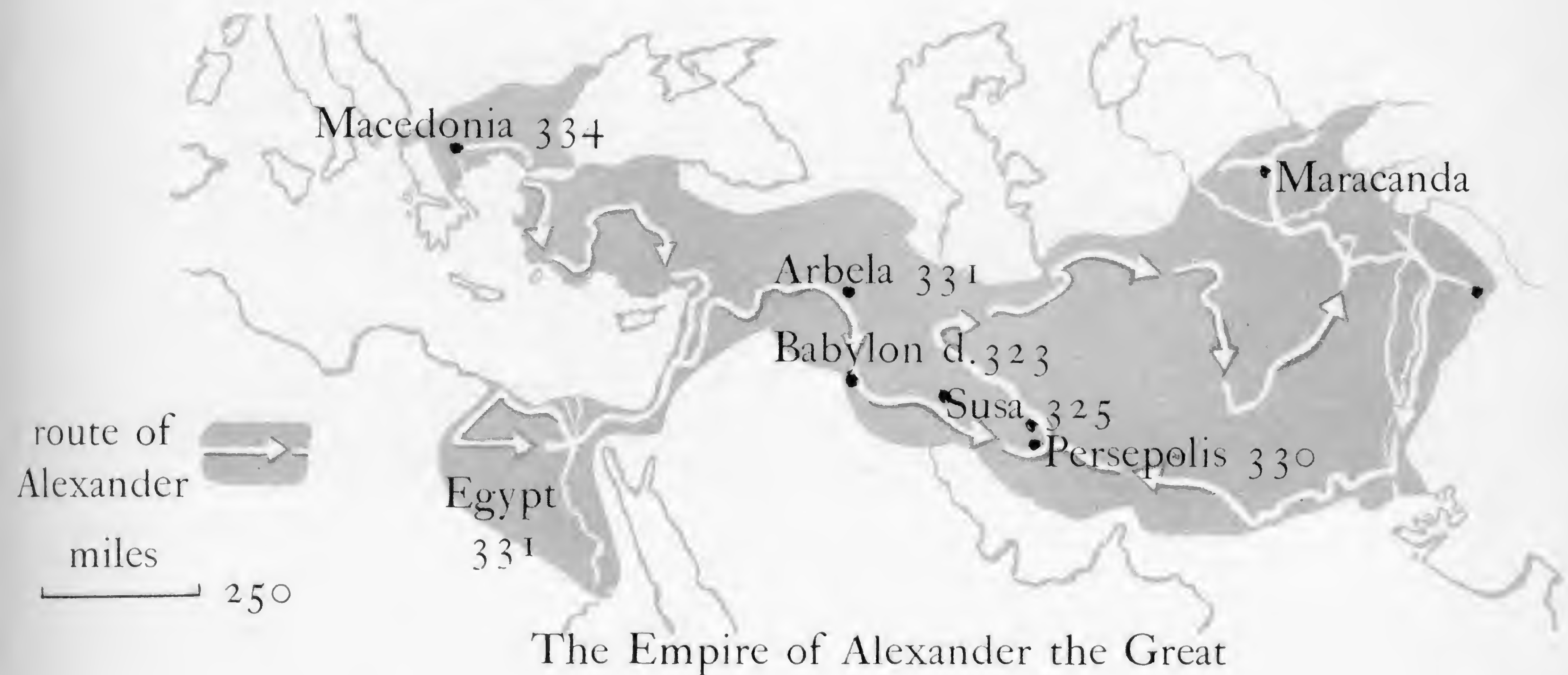




# INTRODUCTION

## HELLENISTIC

492-479	444-429	334-323	146	31 B.C.
War with Persia	Ascendancy of Athens	Alexander the Great King of Macedon	Greece a Roman province	
	431 — 404			
	Peloponnesian War	323	Euclid 283	
	429/8	Plato 347		
	384	Aristotle 332		



The Aegean Period. 1 No records survive of the Minoan sea-kings of Crete except remains of palaces, e.g. Cnossus. 2 The Mycenaeans built massive citadels with Cyclopean masonry and domed tholos tombs on the mainland. The Aegean civilization fell before the Homeric Greeks.

The Hellenic Period. The Greeks called themselves Hellenes (Hellas was called Graecia by the Romans). They formed numerous small city states in which primitive houses surrounded a citadel and later a temple built on an acropolis or upper city. National unity was achieved by pan-Hellenic festivals held at Olympia, Delphi, Argos and Corinth every few years.

The Hellenistic Period began with the Empire created by Alexander the Great when many new cities were founded with monumental buildings.

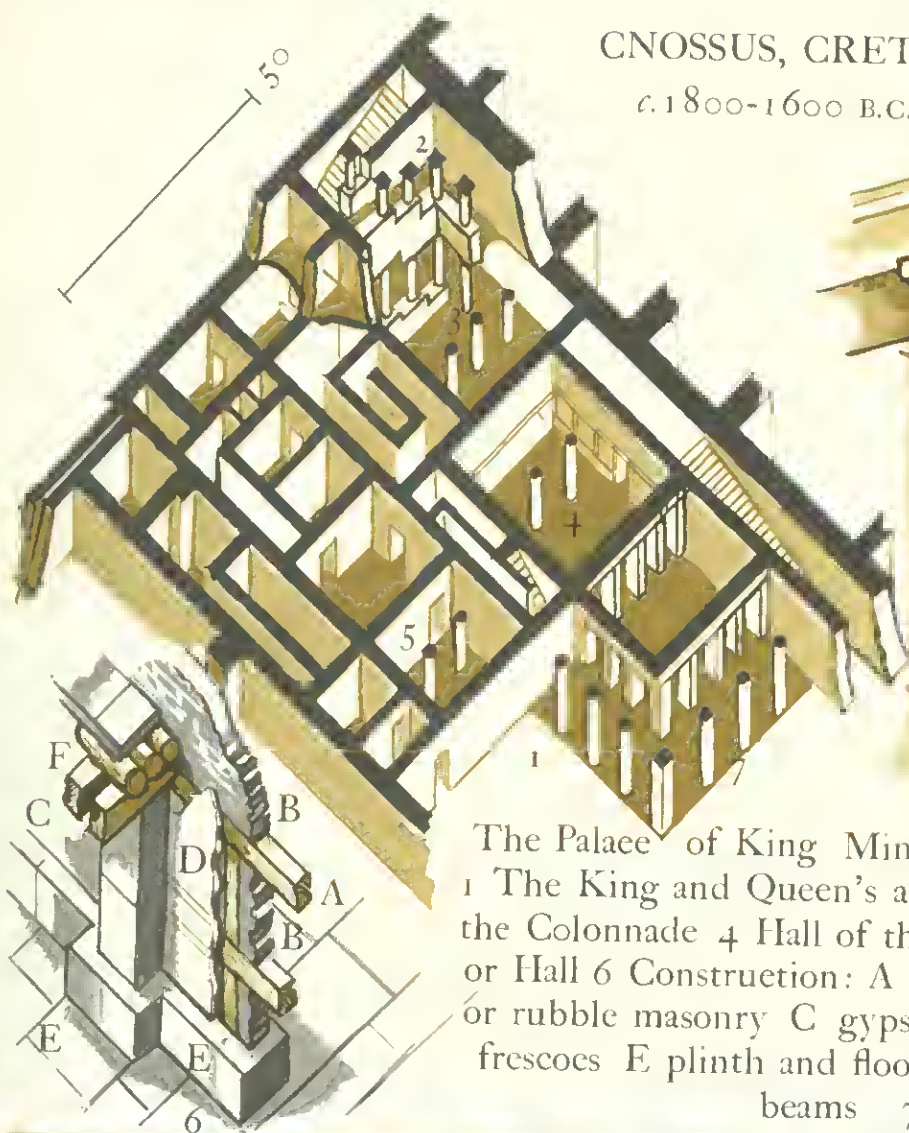
The Greek temple developed from the Mycenaean megaron built of sun-dried brick, stone and timber to house a deity and to be looked at from outside, not to contain a congregation within. The arch was known to the Greeks, but they based their temples on the column & beam. These developed from the 6th-4th centuries B.C., each with its own ratios of proportions established by experience. Columns were often placed closer than necessary to support the entablature in order to create a repetitive rhythm of solids and voids. Optical refinements displaying an appearance of vitality and strength have been measured in a number of them. Many architects wrote treatises about their buildings, cited by Vitruvius (1st cent. B.C.) who classified their plans and proportions.



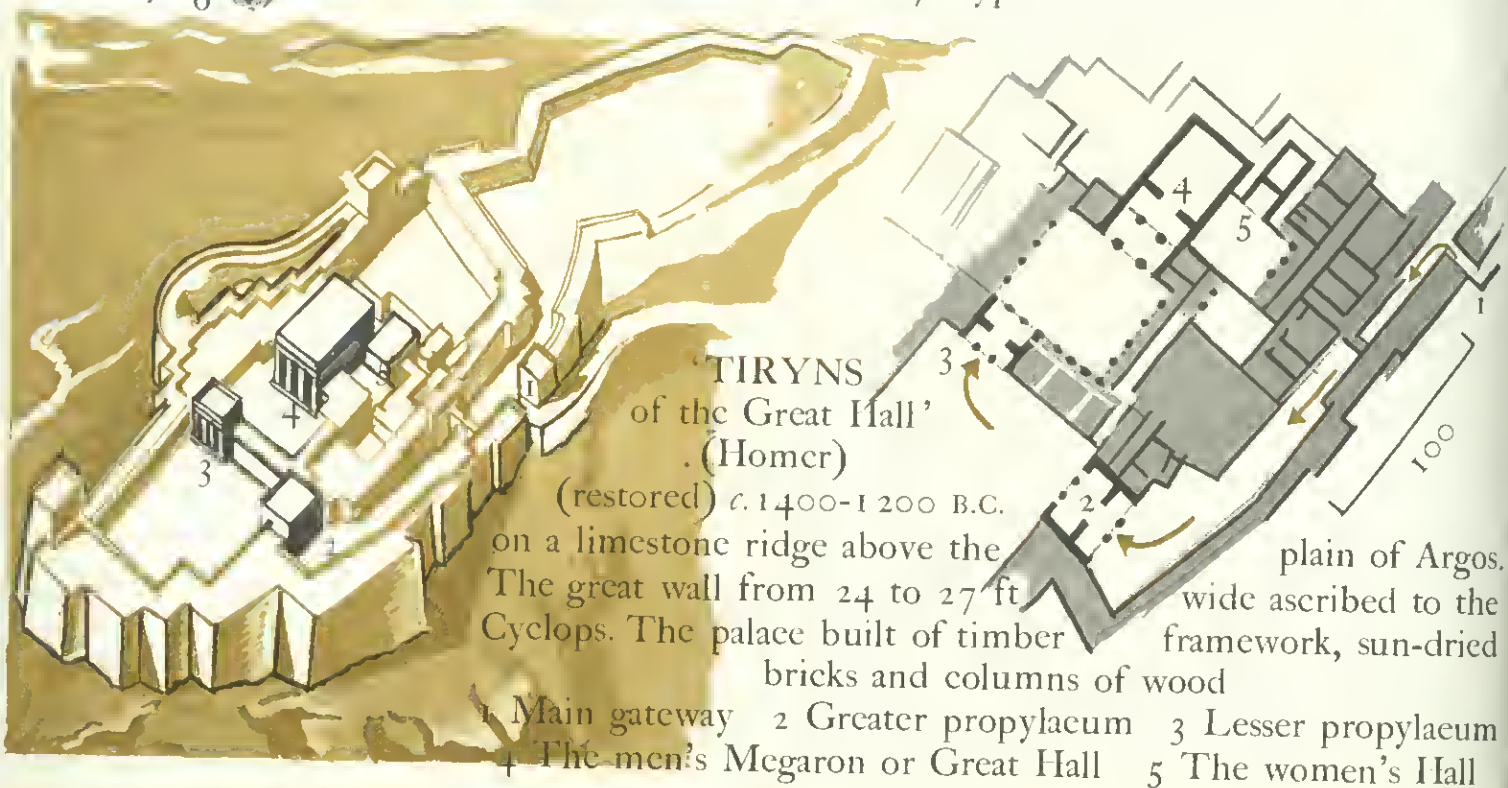
# GREEK

## CNOSSUS, CRETE

c. 1800-1600 B.C.



The Palace of King Minos (restored), c. 1800-1600 B.C.  
 1 The King and Queen's apartments 2 Great staircase 3 Hall of the Colonnade 4 Hall of the Double Axes 5 Queen's Megaron or Hall 6 Construction: A timber framework B sun-dried brick or rubble masonry C gypsum slabs or D plaster painted with frescoes E plinth and floor of gypsum or limestone F ceiling beams 7 Cypress columns



## TIRYNS of the Great Hall' (Homer)

(restored) c. 1400-1200 B.C.

on a limestone ridge above the plain of Argos. The great wall from 24 to 27 ft wide ascribed to the Cyclops. The palace built of timber bricks and columns of wood

1 Main gateway 2 Greater propylaeum 3 Lesser propylaeum 4 The men's Megaron or Great Hall 5 The women's Hall



# THE AEGEAN

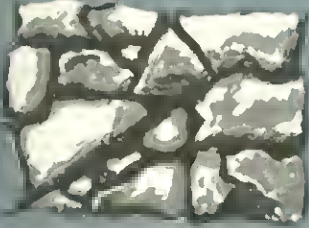


MYCENAE (restored), c.1350 B.C.

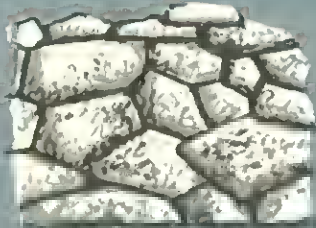
The citadel palace of Agamemnon, Cyclopean walls of boulders weighing 5 to 6 tons were eased into alignment on pebbles



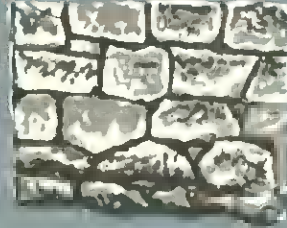
Lion Gate, Mycenae, c.1200 B.C.



Cyclopean wall, Tiryns



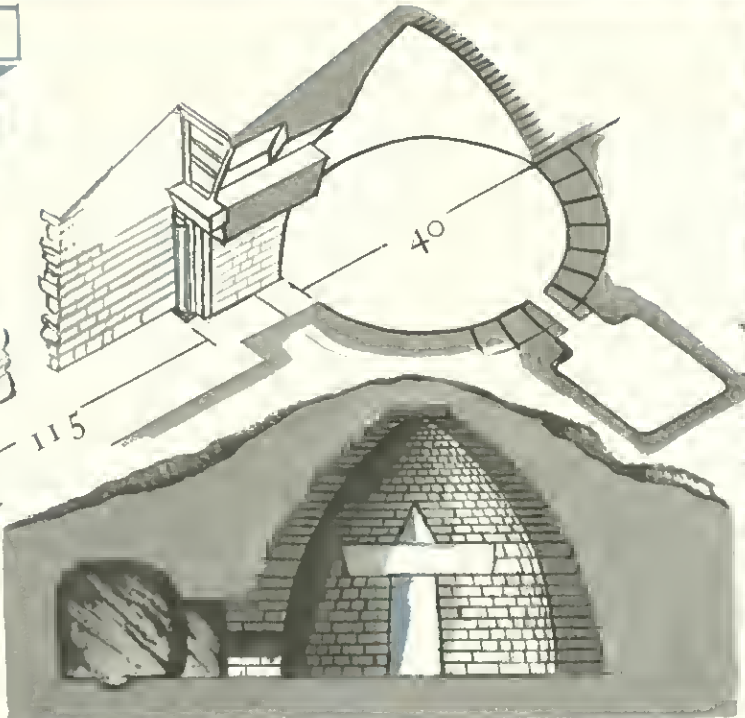
Polygonal, Mycenae



Curvilinear, 7th cent



Rectangular, 5th cent.



MYCENAE, The Treasury of Atreus, 1330-1300 B.C. One of some 40 beehive or tholos tombs on the Greek mainland. Built of horizontal overlapping courses of lime-stone or corbelling without centering. The door-way flanked by 2 green sandstone half-columns with a relieving triangle above

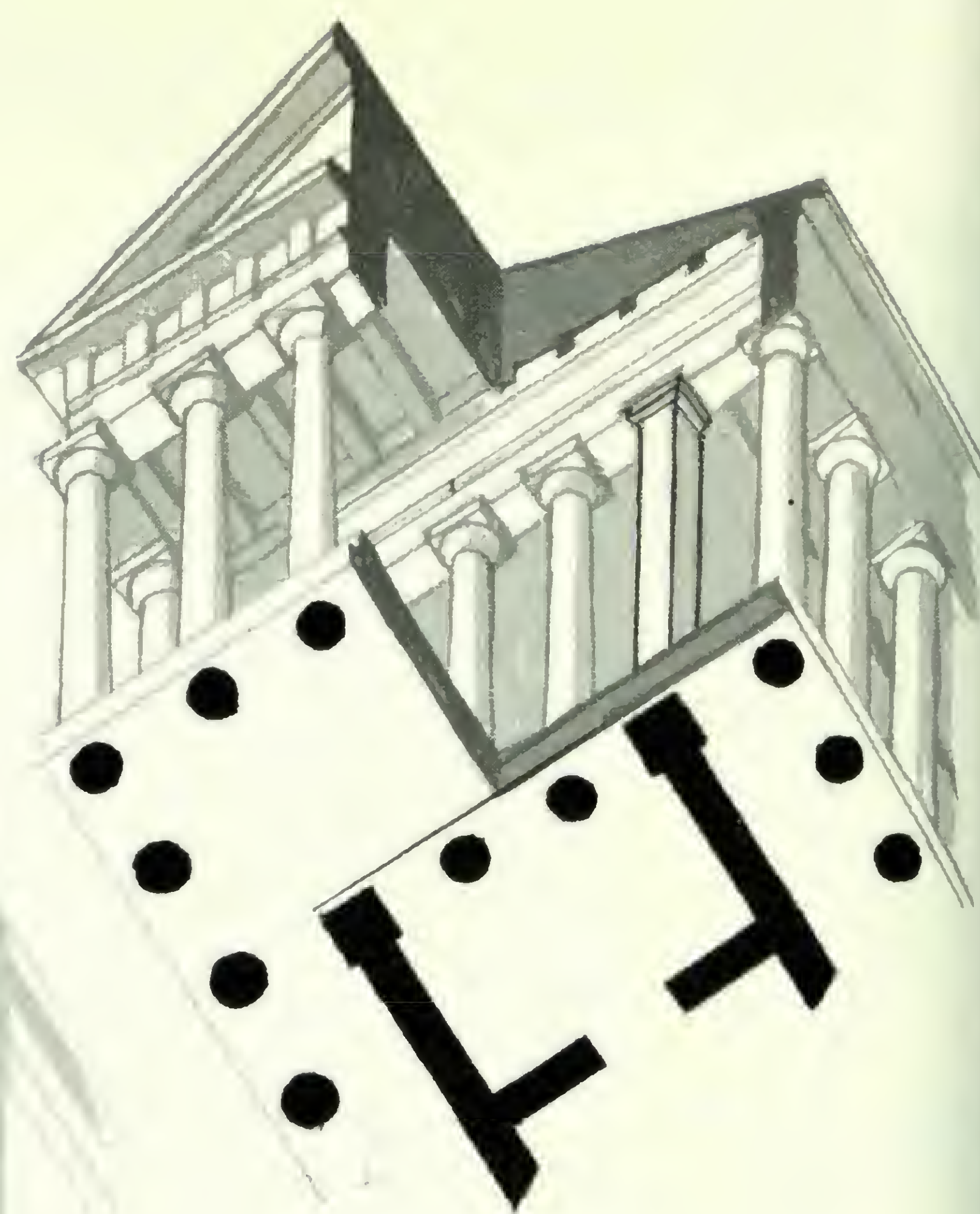
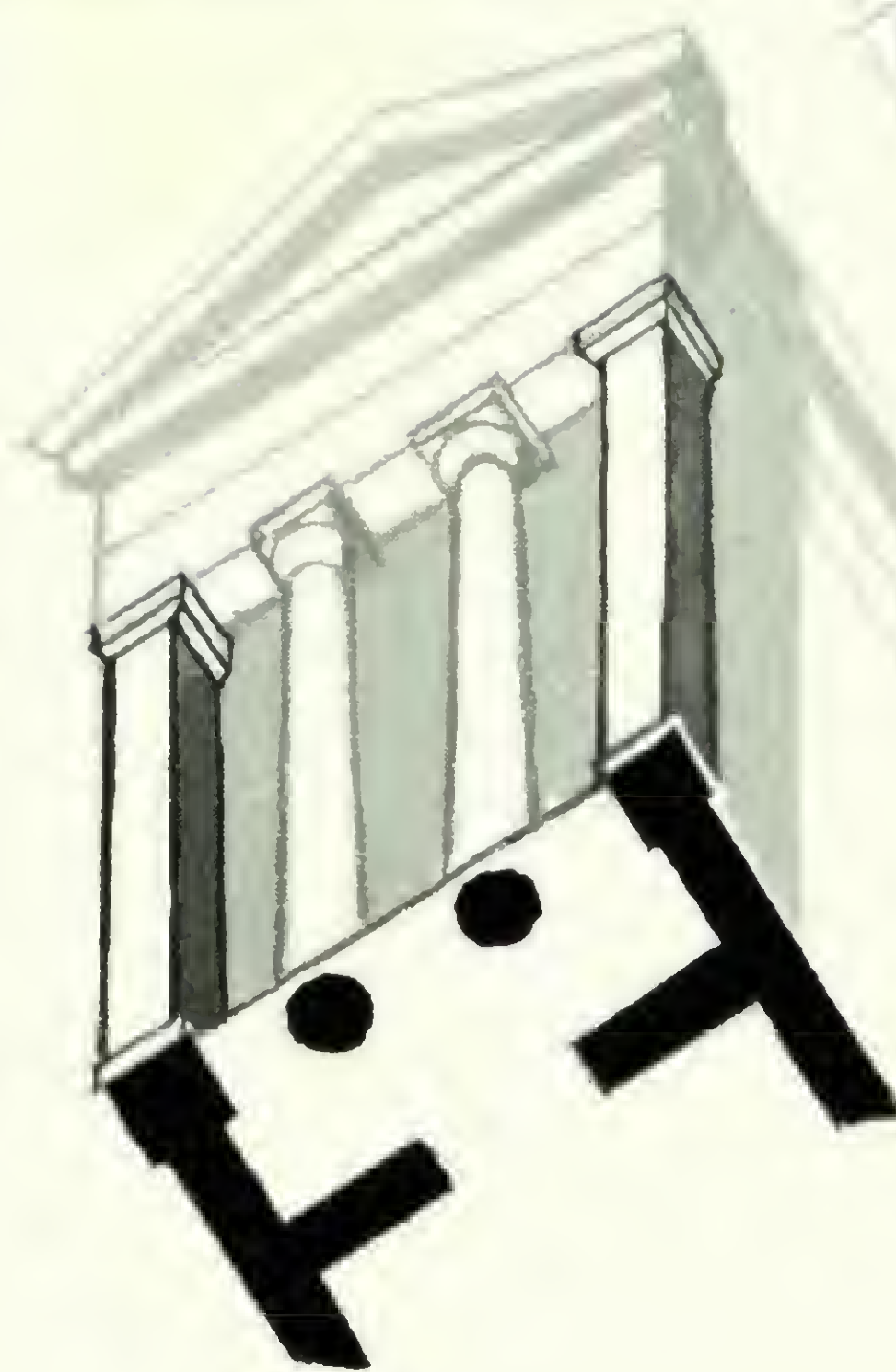
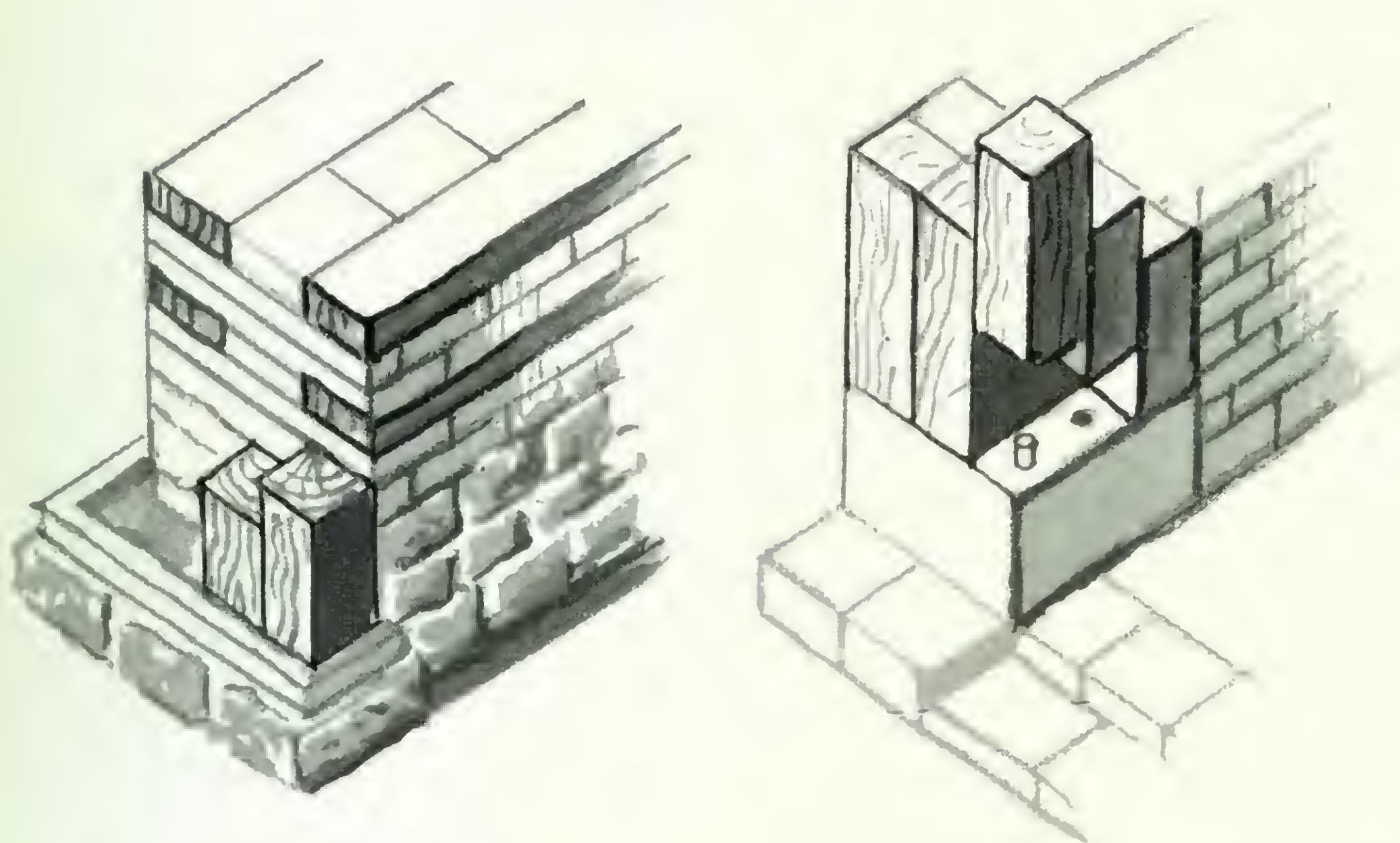




# GREEK

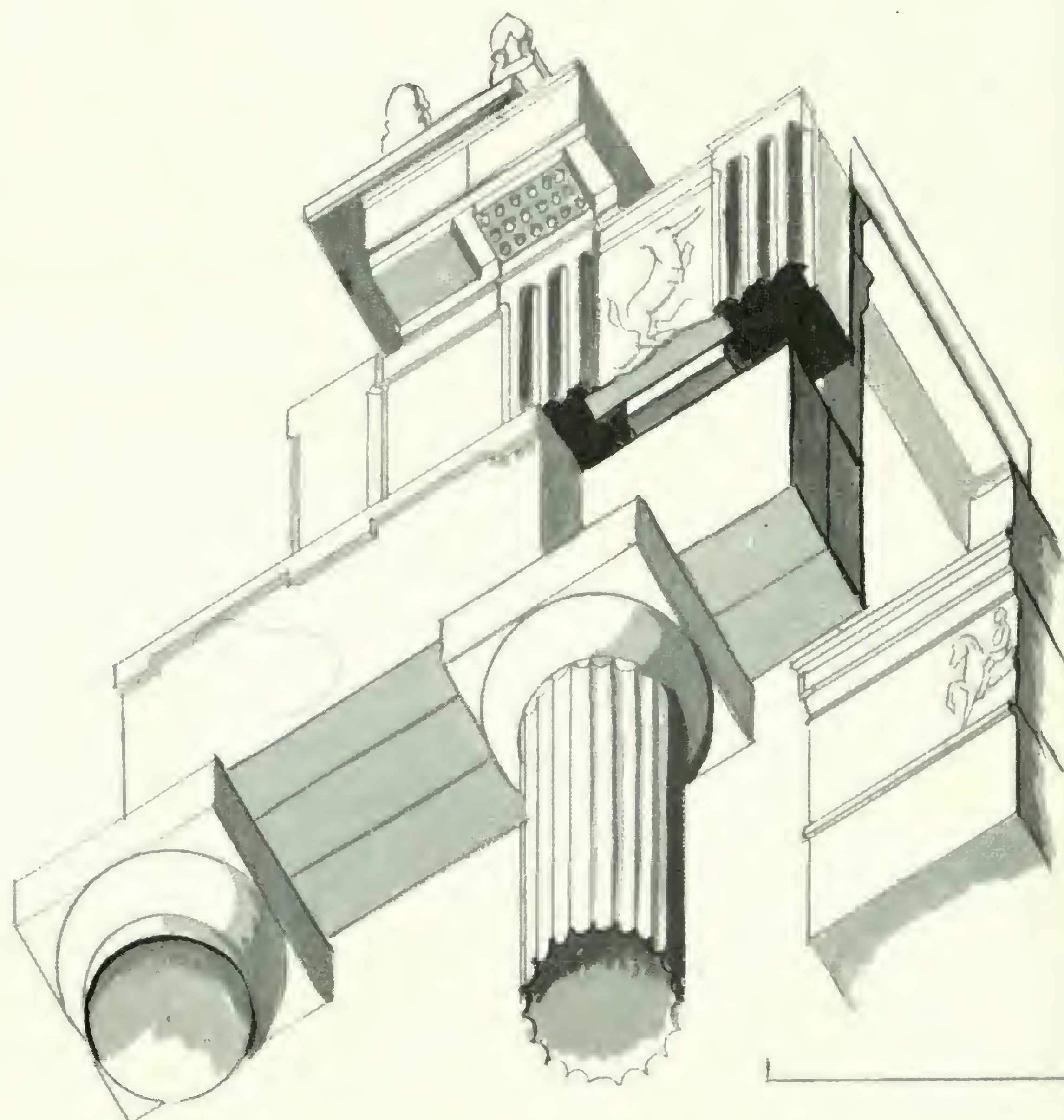
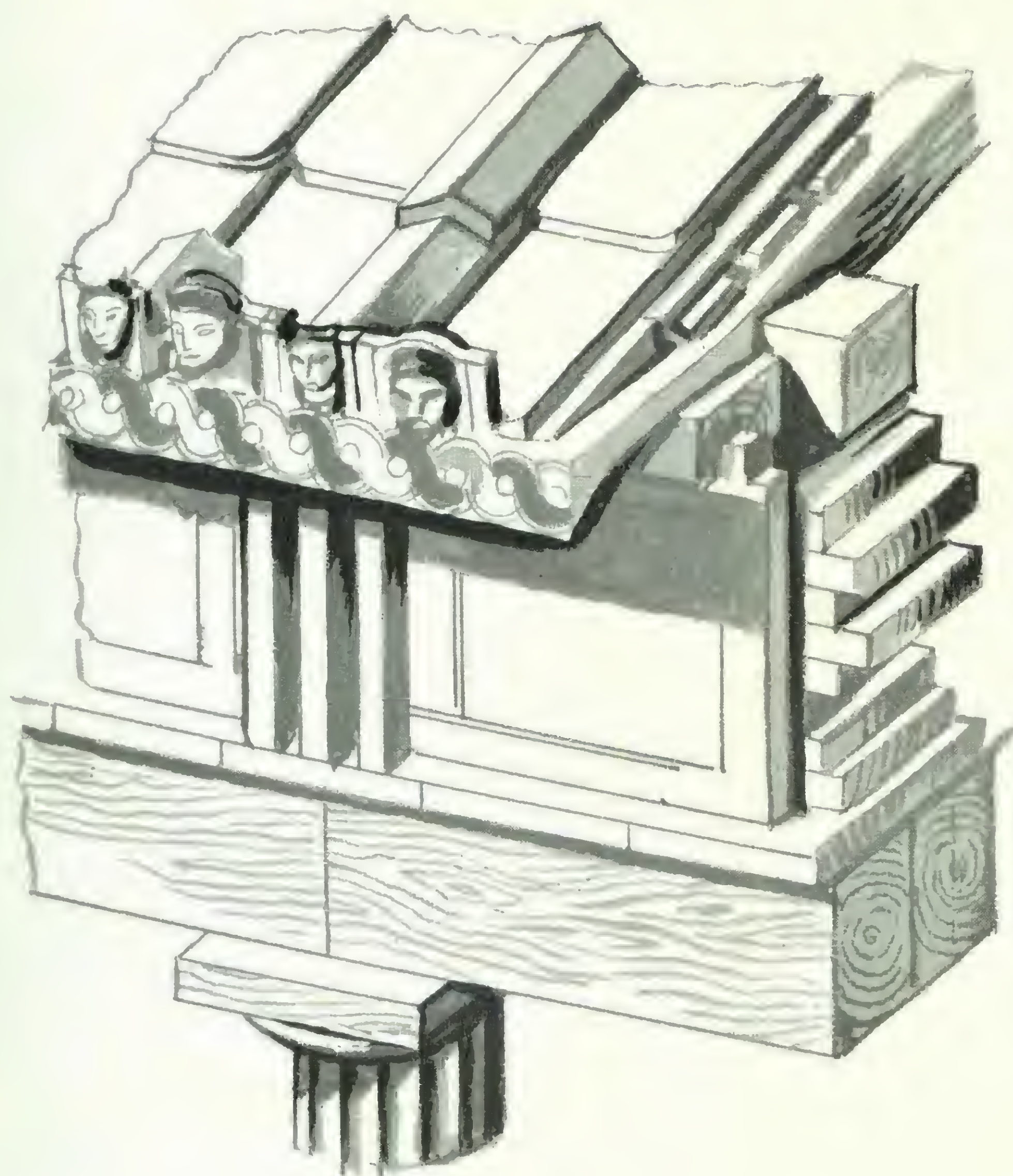


COLUMN AND BEAM



Stone beams of great span are liable to fracture, therefore columns were placed close together

TIMBER TO STONE ANTAE OR PILASTERS

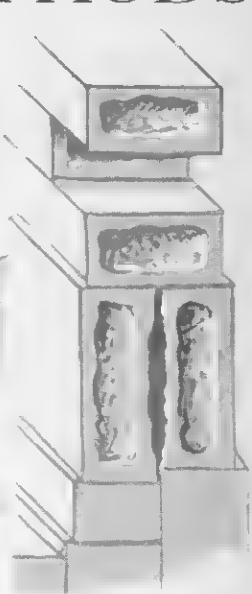
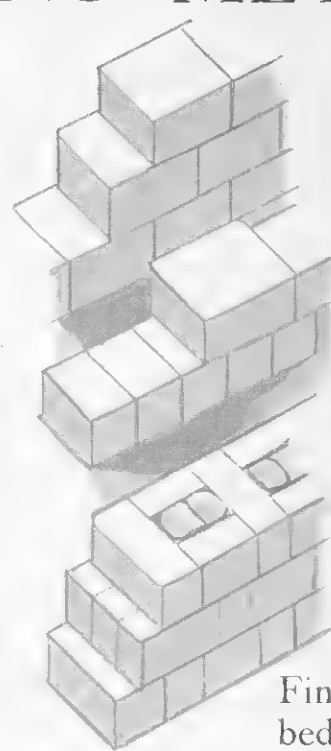
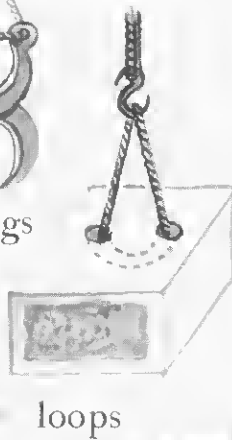
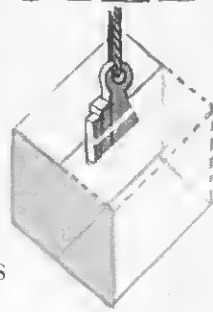
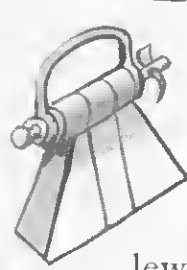
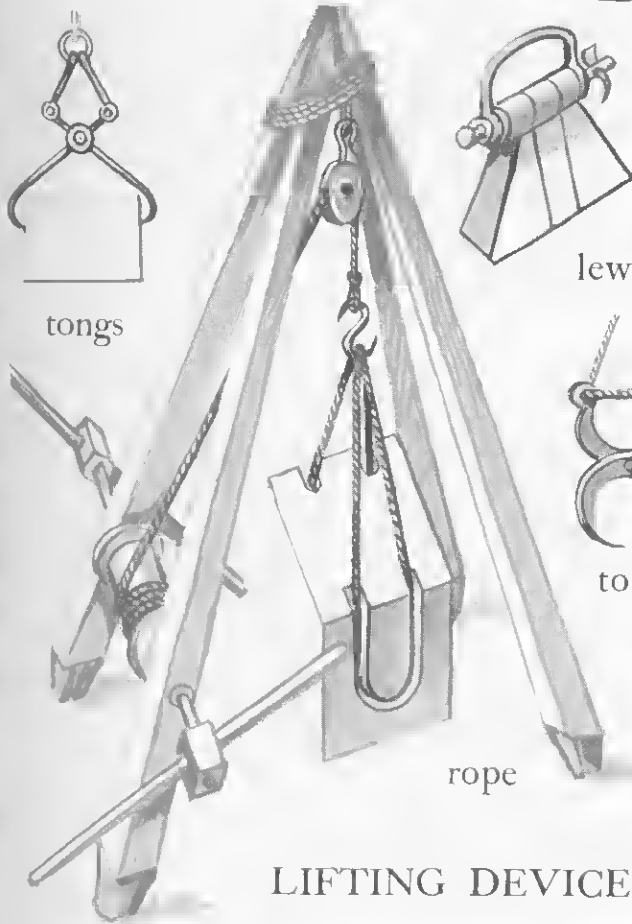
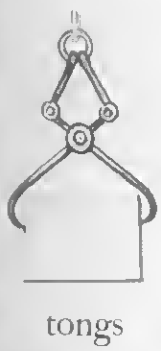


TIMBER construction, *c.*620 B.C.  
Doric temple of Apollo, Thermum.  
Wooden entablature and columns

MARBLE construction, *c.*477-438 B.C.  
The Parthenon, Athens



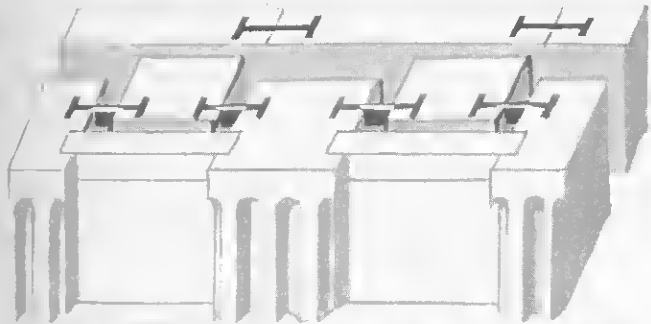
# BUILDING METHODS



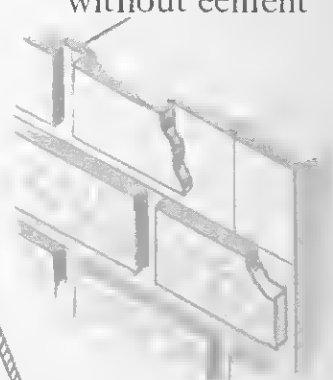
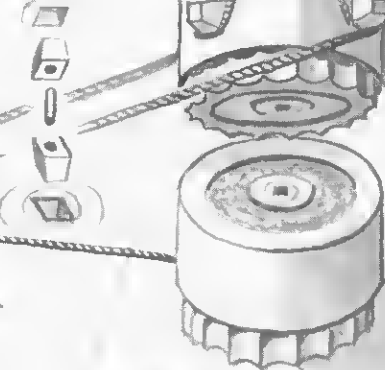
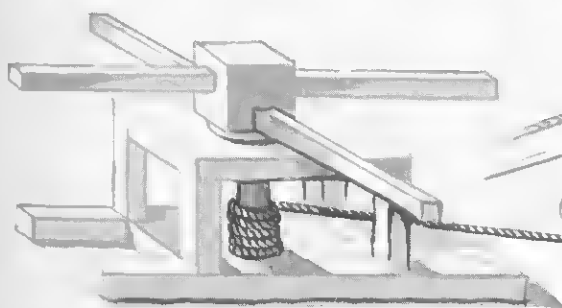
## MASONRY

Fine squared ashlar bedded and jointed without cement

## LIFTING DEVICES



METAL CRAMPS set in molten lead



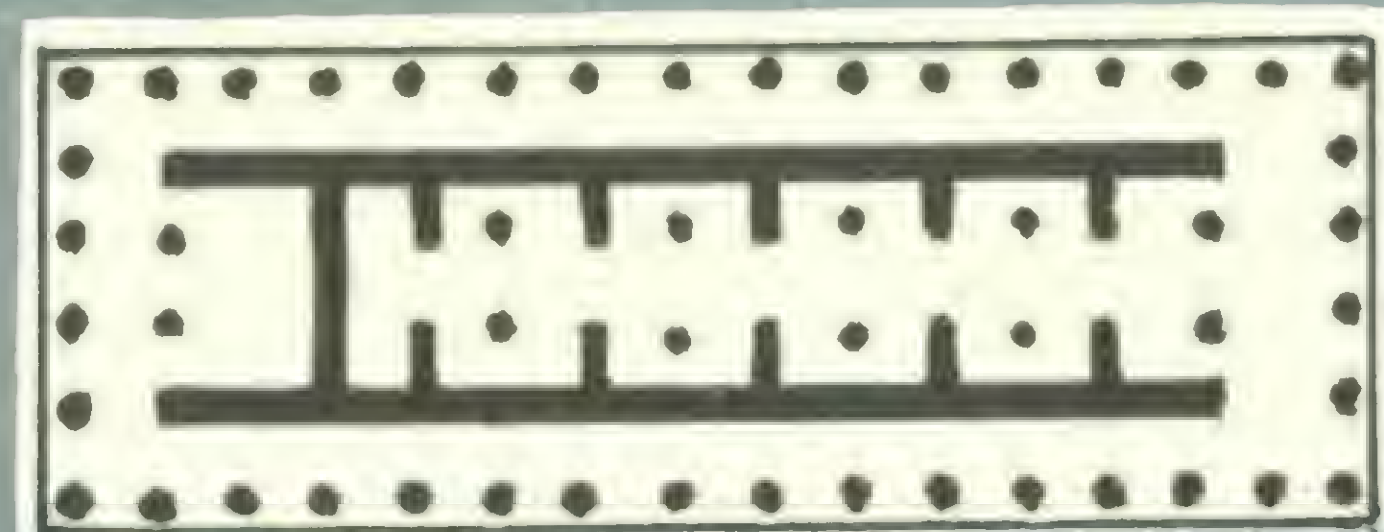
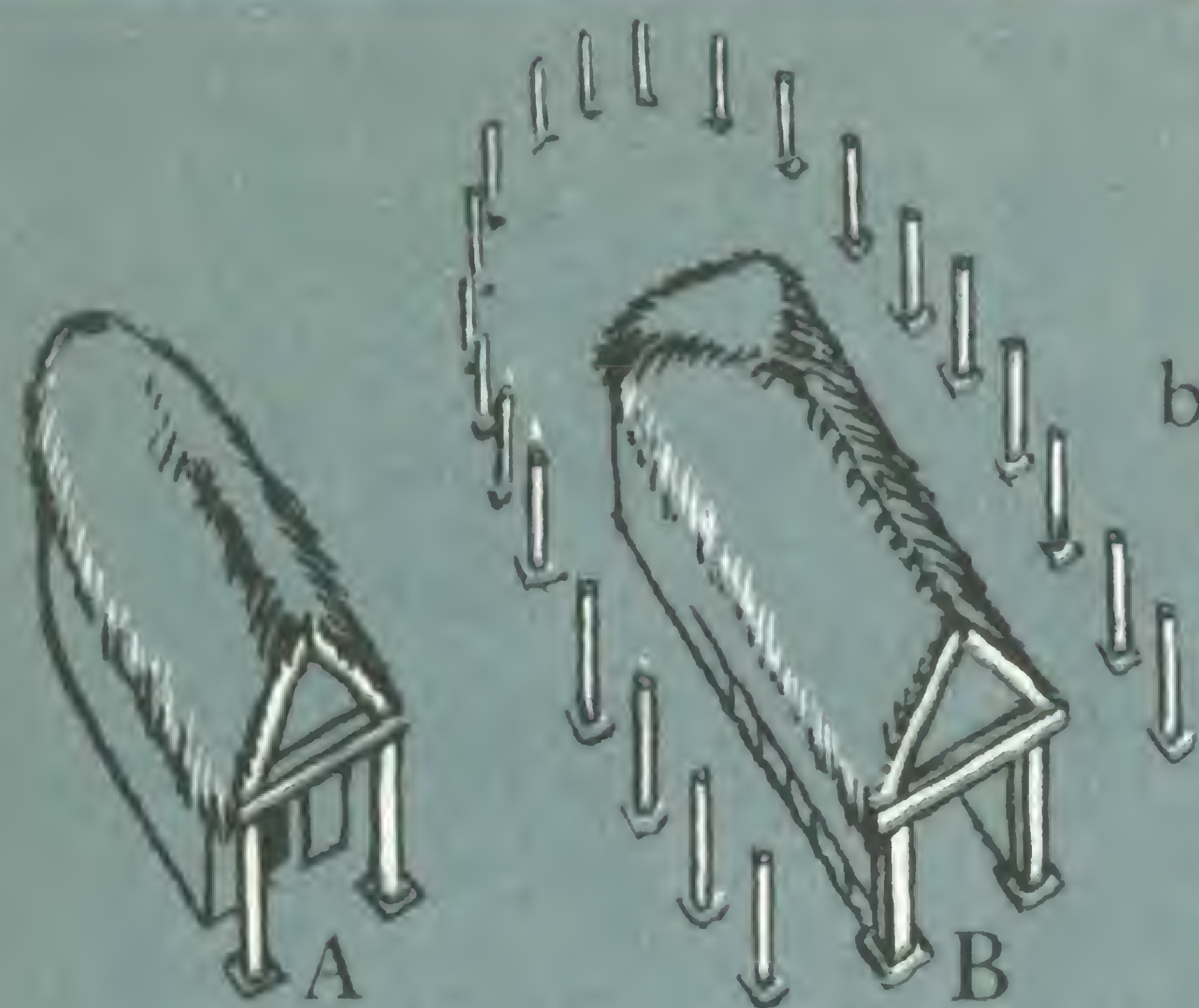
Stone left undressed to avoid damage in transport

ERECTION OF

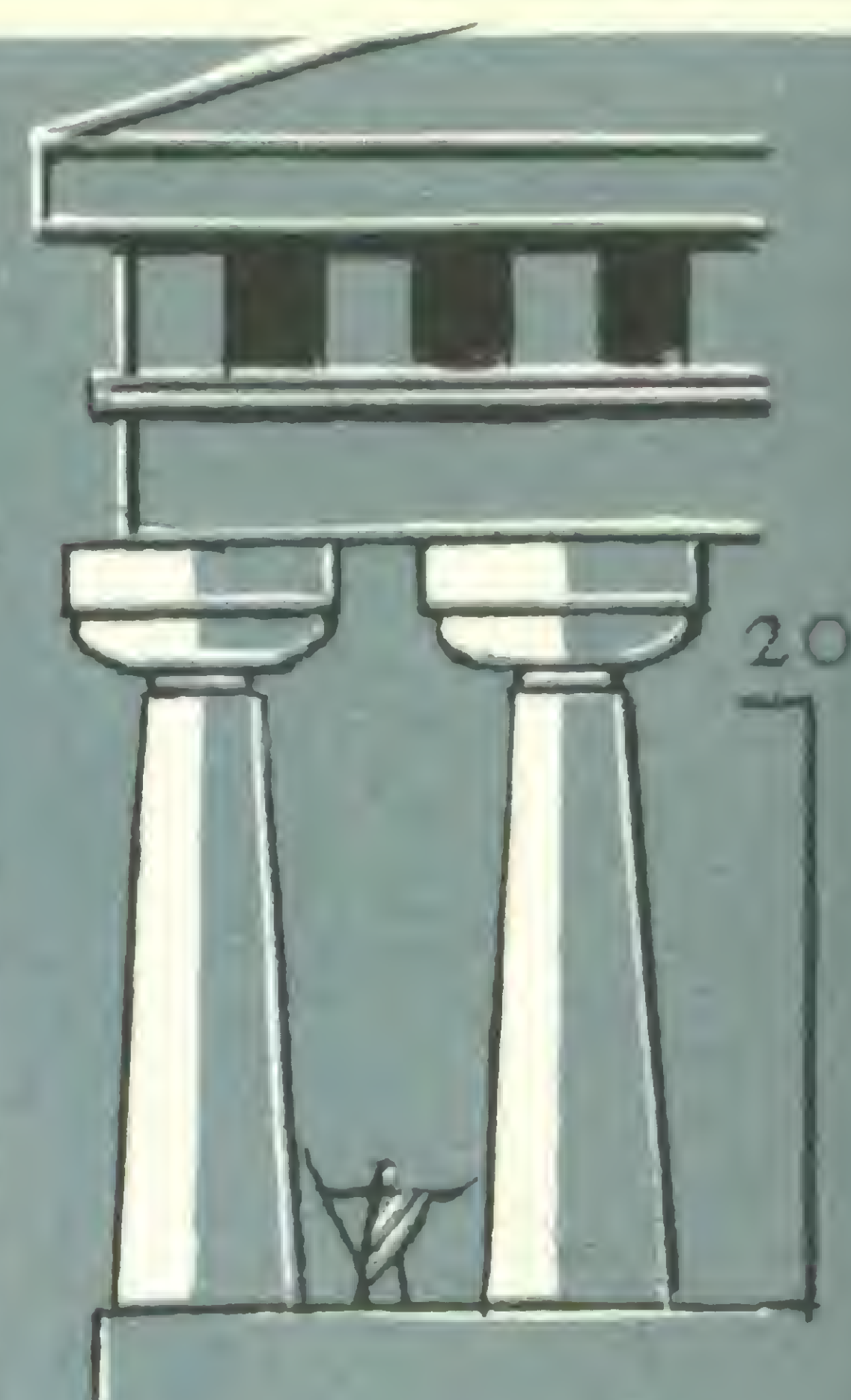
A COLUMN



# GREEK



The Heraeum,  
Olympia, c.649 B.C.  
Walls sun-dried  
brick. Stone replaced wood columns as they  
decayed. Gable roof with terracotta tiles

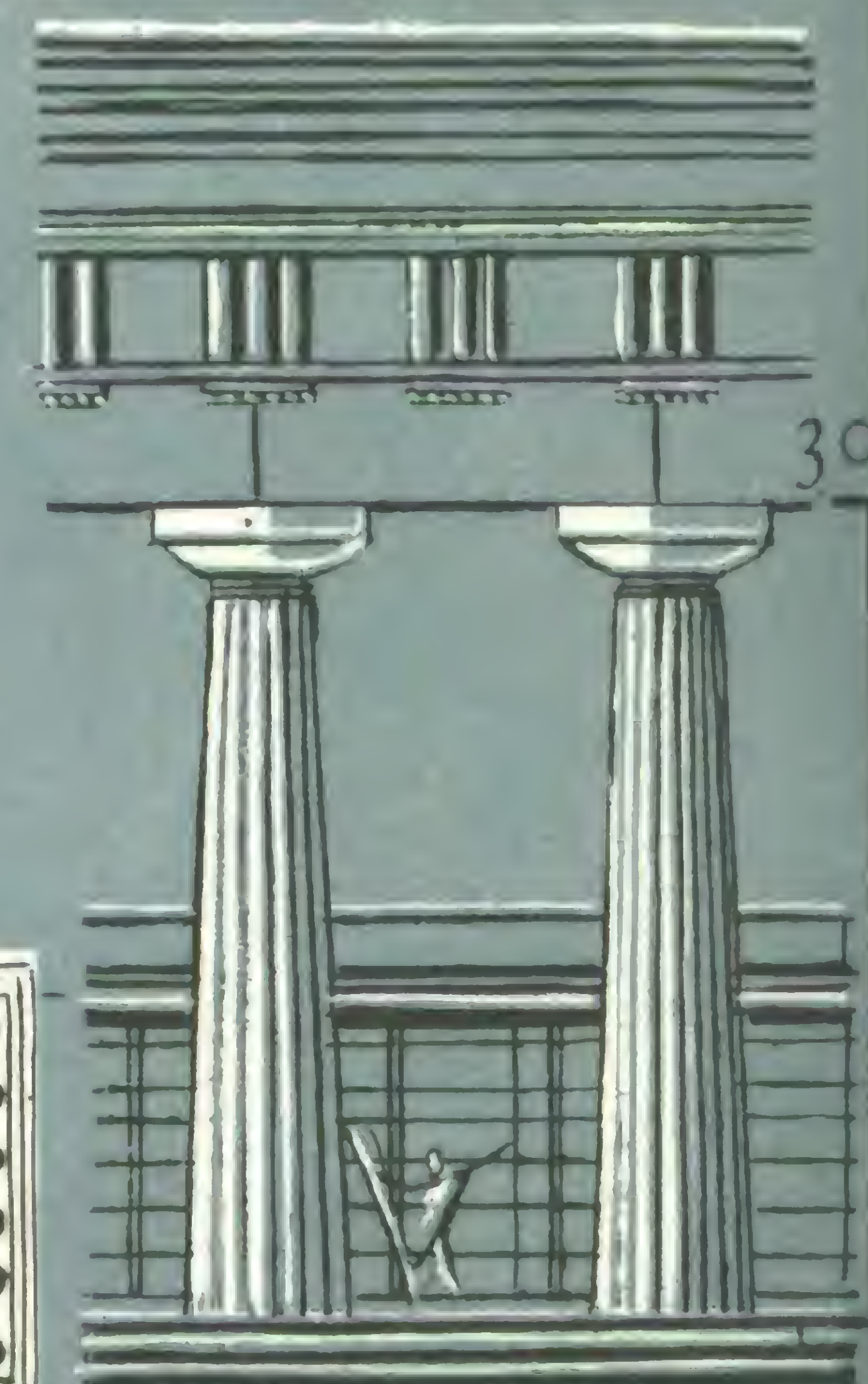


Temple of Apollo, Syracuse, c.575 B.C.  
Monolithic stone columns



Sanctuary of Thermum, Aetolia

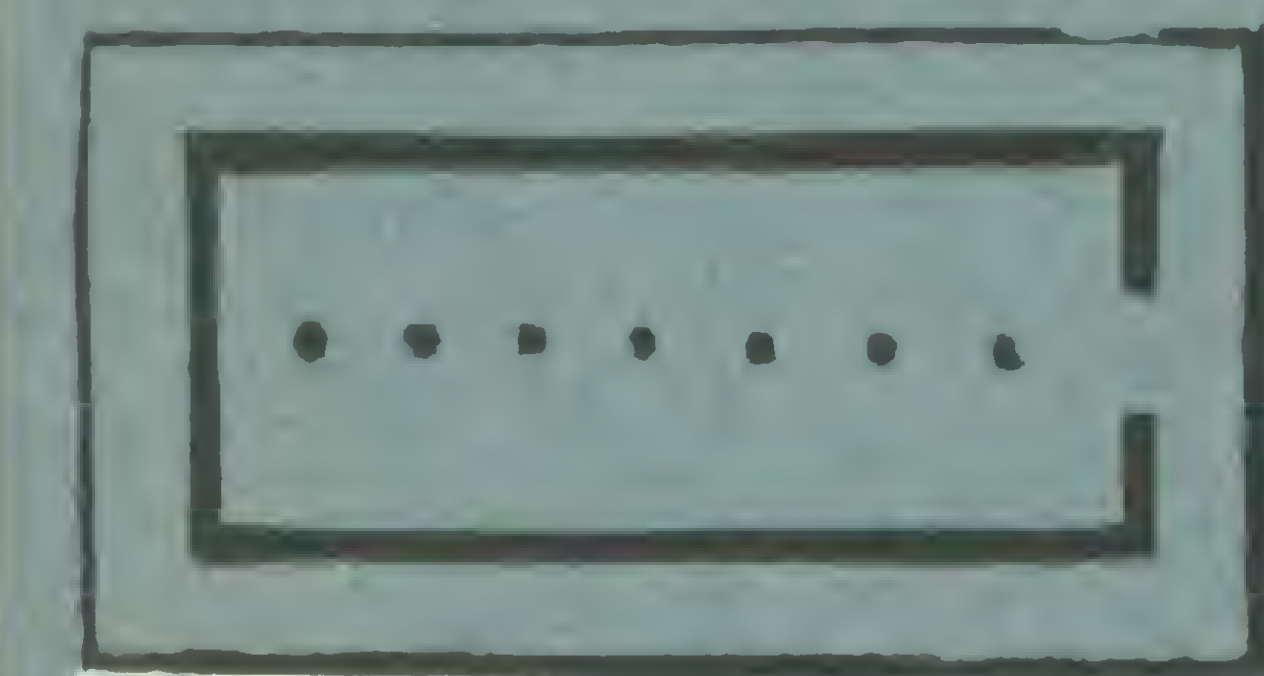
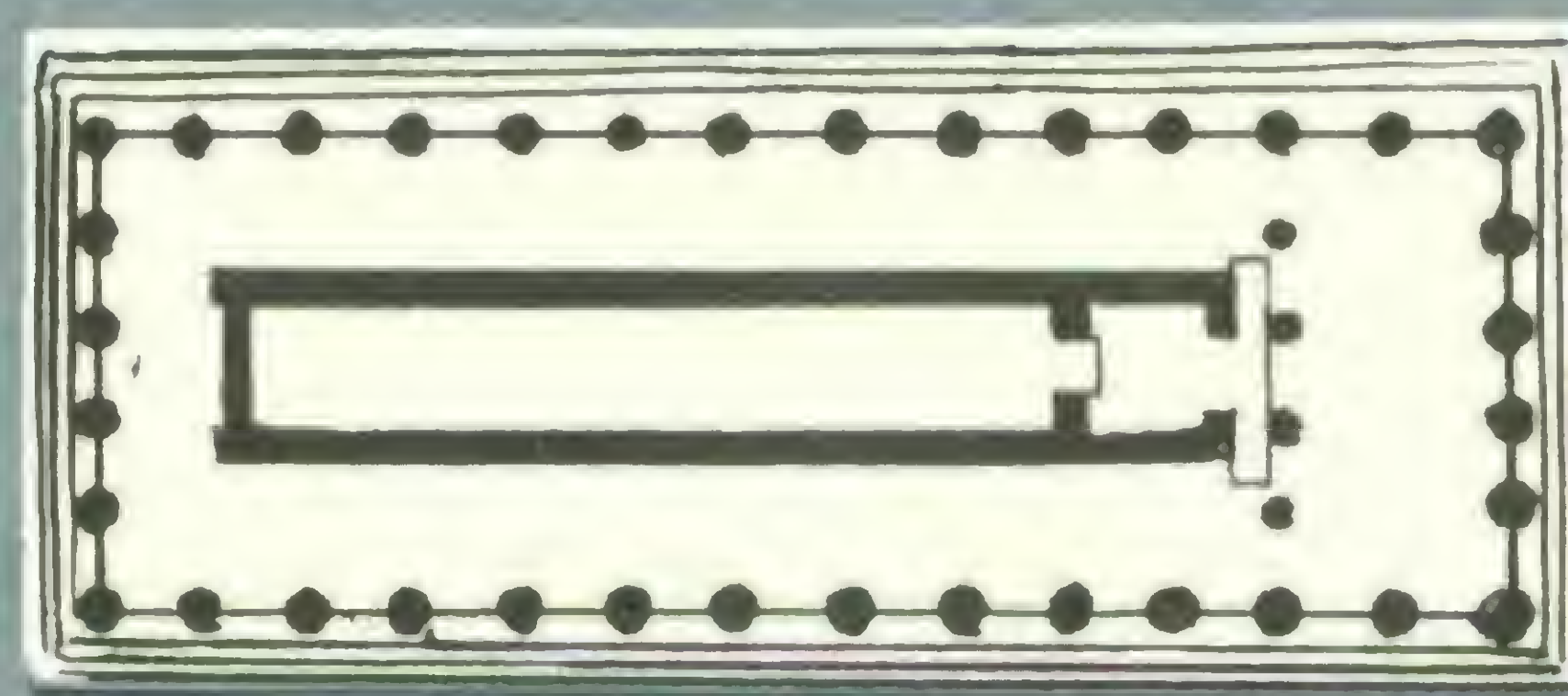
The Temple of Apollo,  
c.600 B.C.,  
built over Megaron B.  
Columns and entablature  
of wood



Temple F, Selinus, c.560 B.C.  
Stone screens join the columns

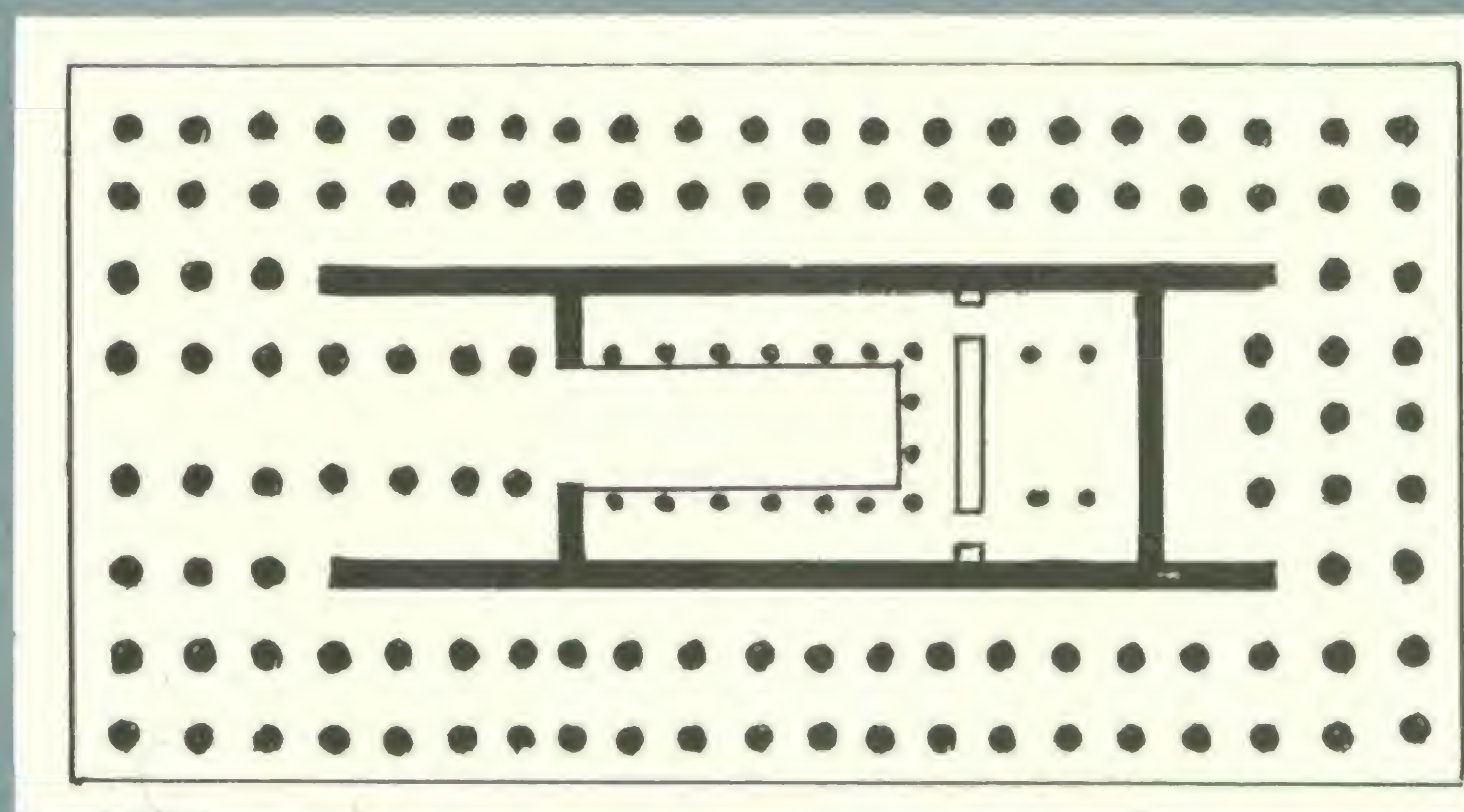
Megaron A,  
c.2000-1500 B.C.  
Small stones  
carry walls of  
wood and clay,  
roof thatched  
with reeds

Megaron B,  
c.1000-800 B.C.  
House or Temple.  
18 posts formed  
the first known  
Greek peripteral  
temple scheme

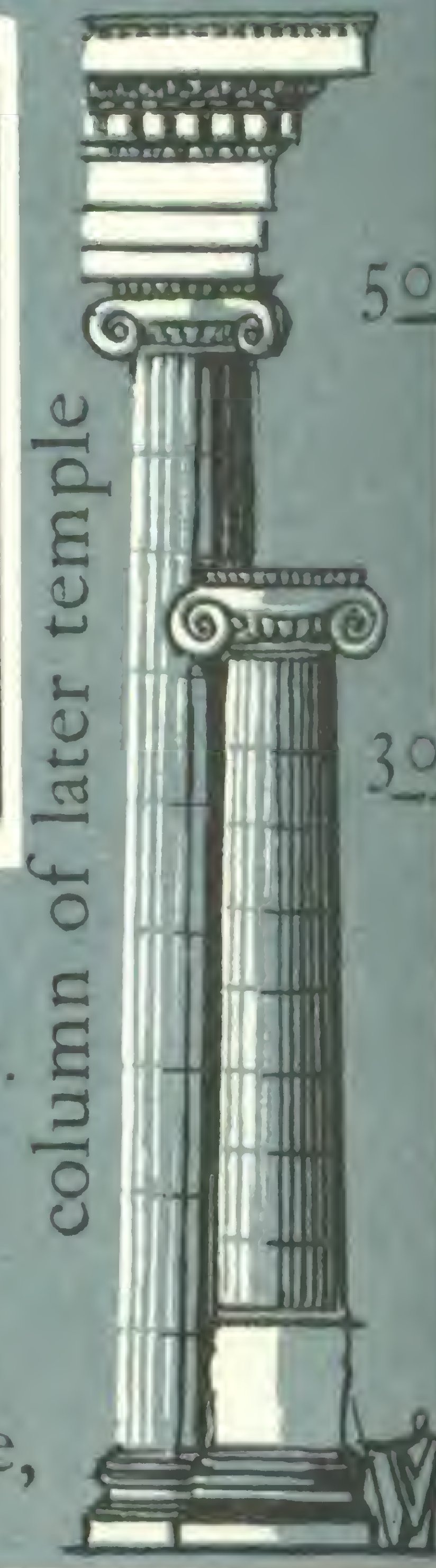


Temple of  
Neandria, Asia Minor,  
c.7th century B.C.

Built of sandstone, roof gabled  
with tiles, 7 stone columns  
have 'Aeolic' capitals,  
i.e. Asiatic-Ionic motifs.

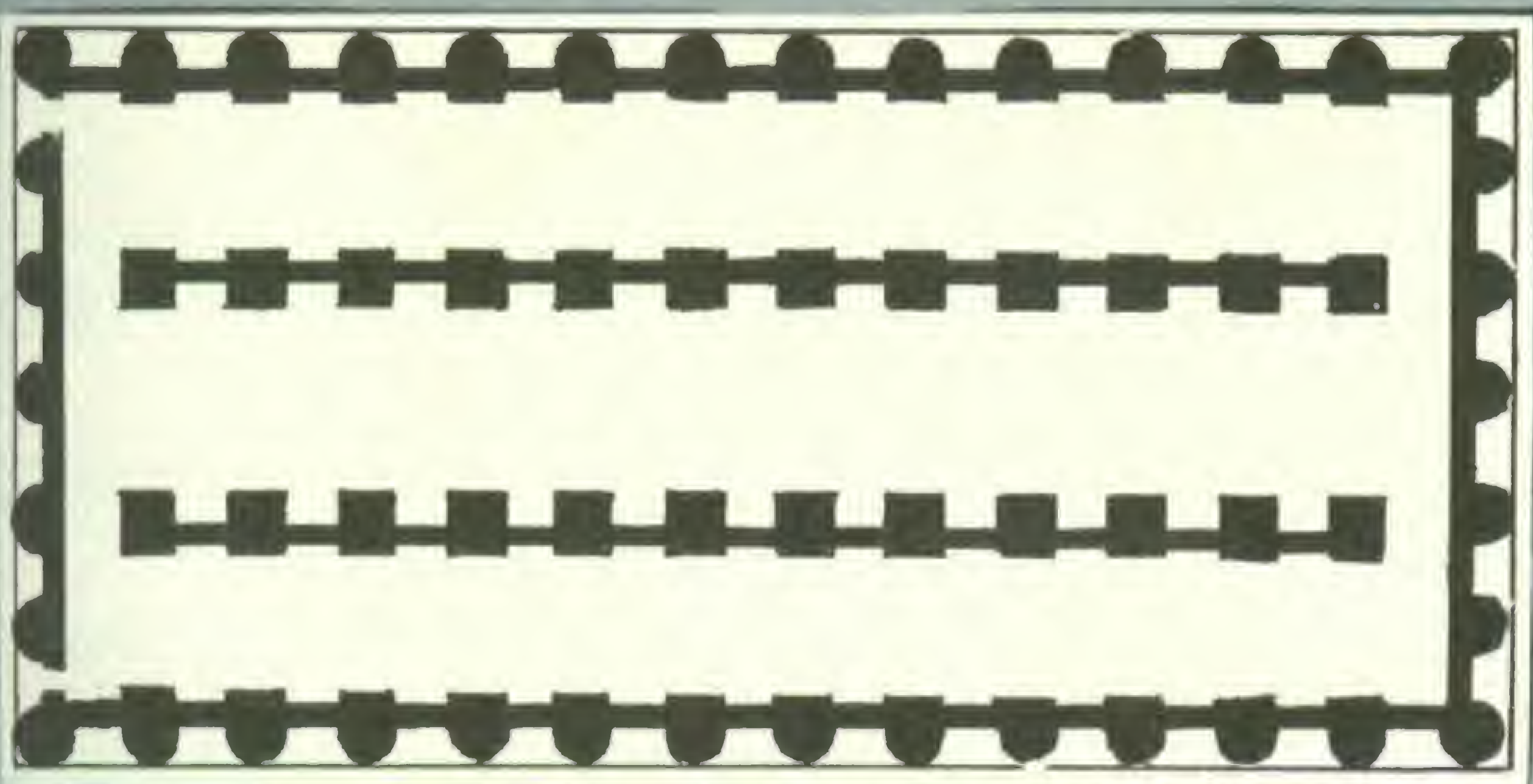


Archaic Temple of Artemis, Ephesus,  
c.560 B.C. Burnt down and rebuilt, 356 B.C.  
Designed by Chersiphron of Cnossus and  
his son Metagenes who wrote a work on  
the temple, now lost, cited by Vitruvius.  
Appearance conjectural, columns of marble,  
walls of limestone faced with marble



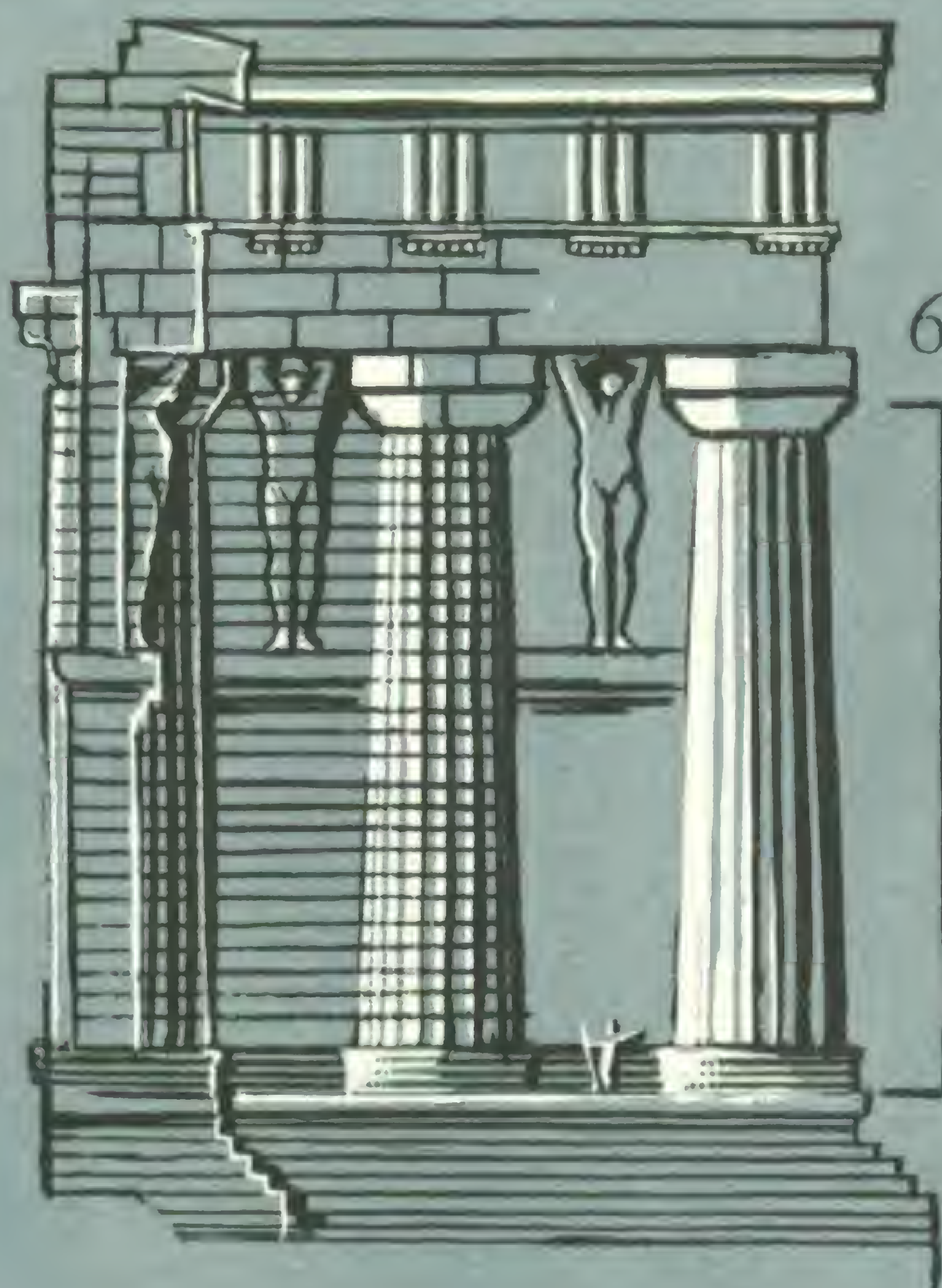


# PLANS, DORIC & IONIC TEMPLES



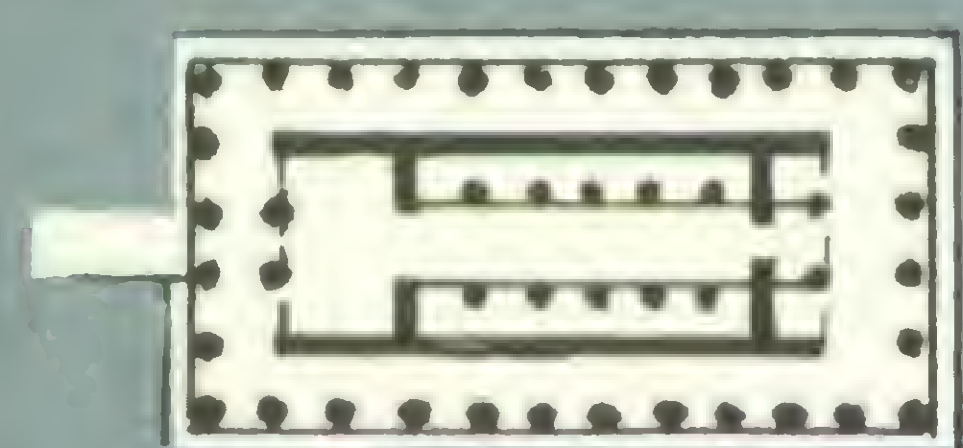
Temple of Zeus Olympius, Agrigento,  
c.480 B.C.

Built of coarse stone faced with marble dust  
cement; position of figures conjectural

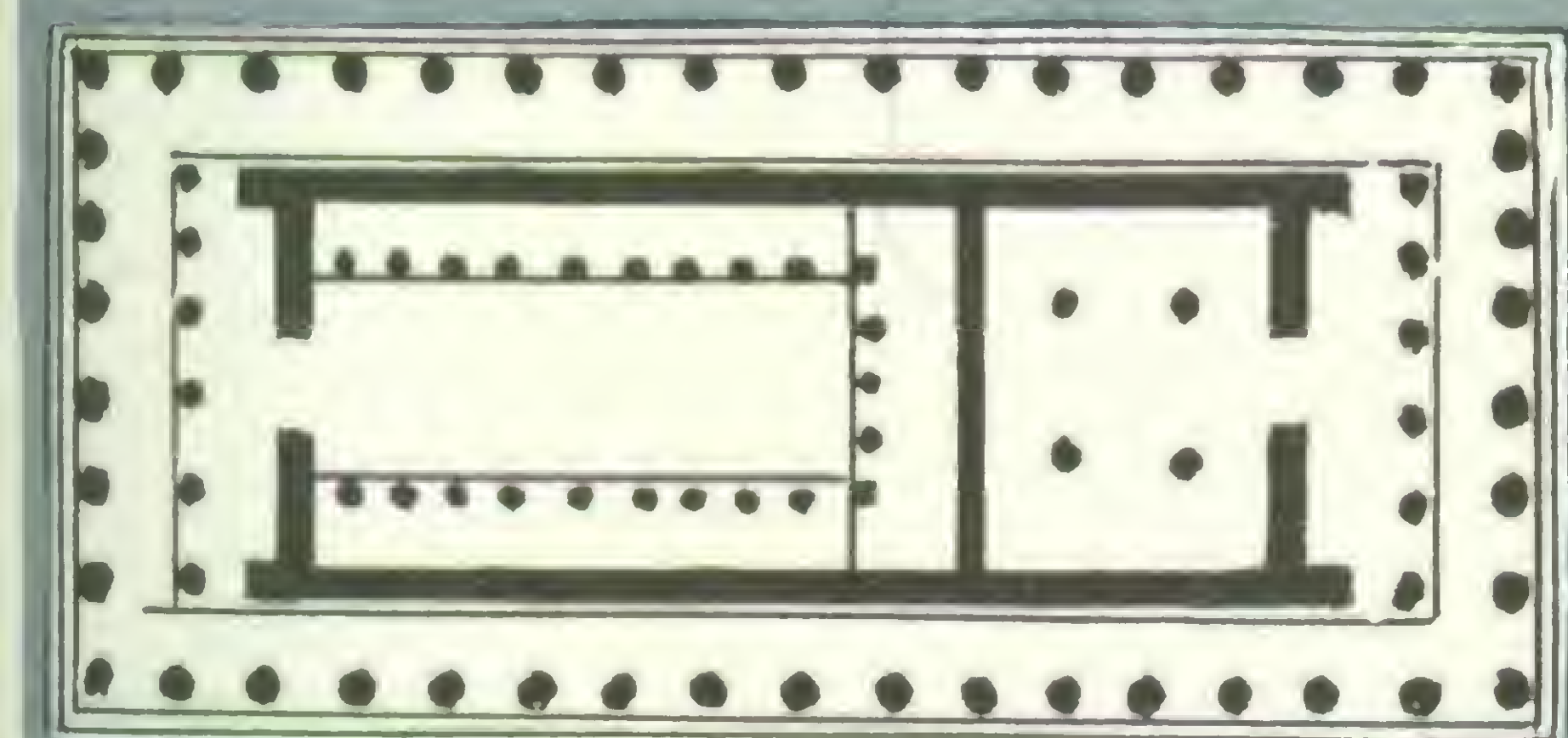


Plans  
drawn in black  
to the same scale

100

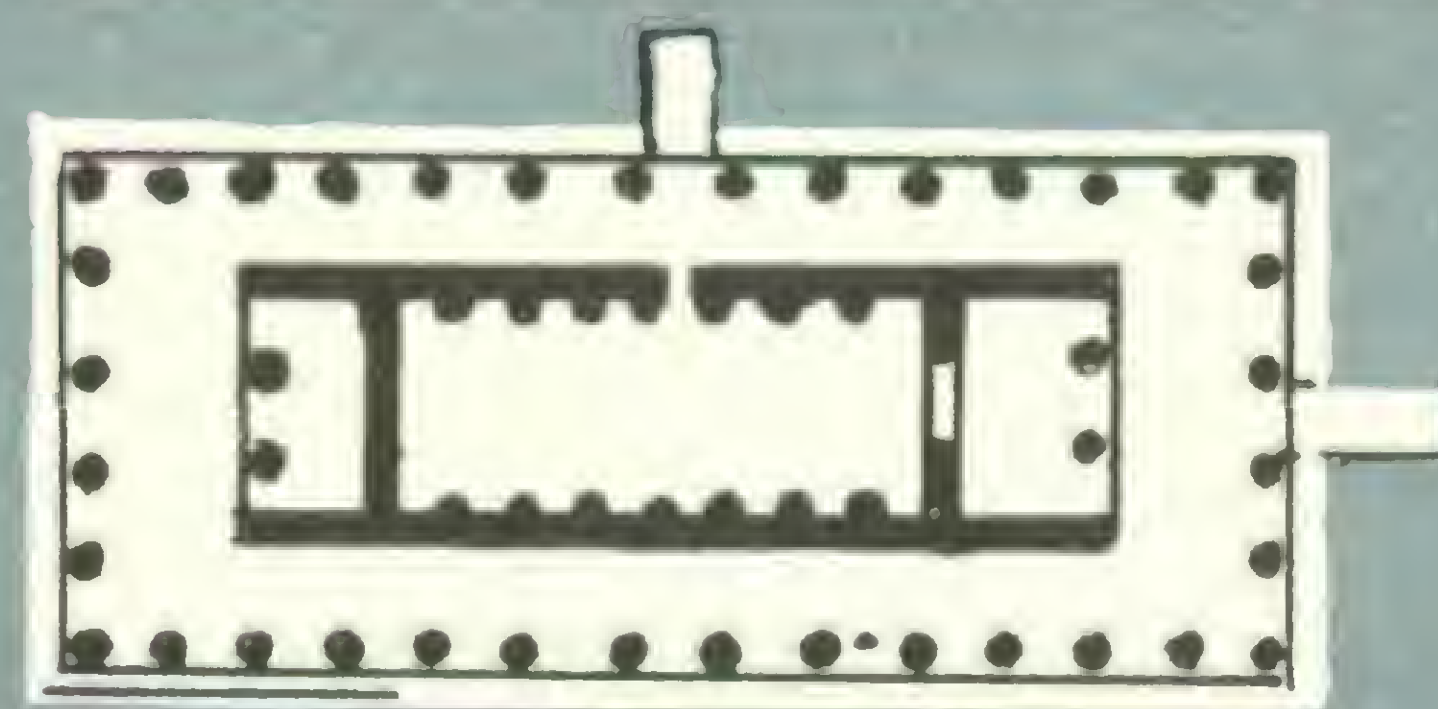
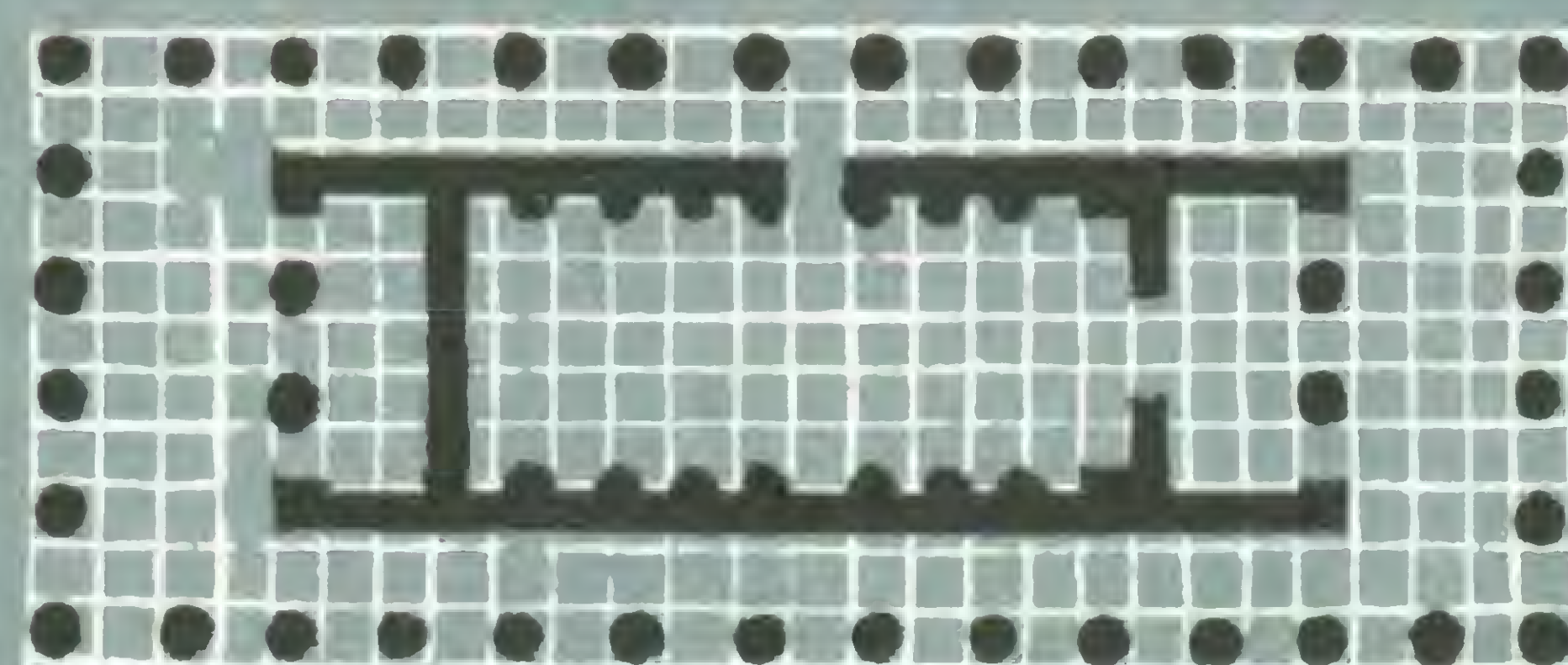


Temple of Aphaia, Aegina,  
c.490 B.C.



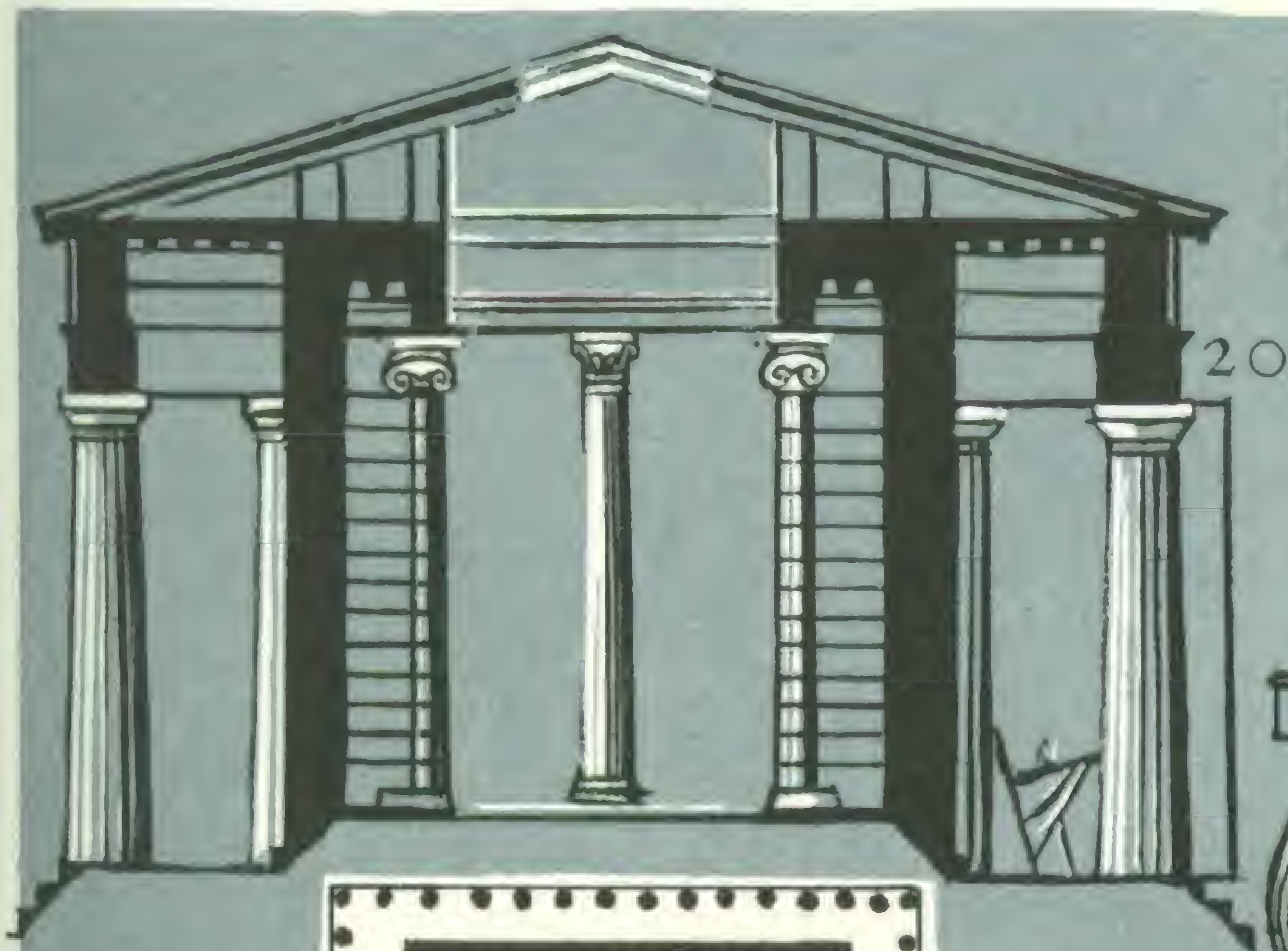
The Parthenon, Athens,  
447-432 B.C.

Ictinus and Callicrates architects, Pheidias  
master sculptor; built of white marble



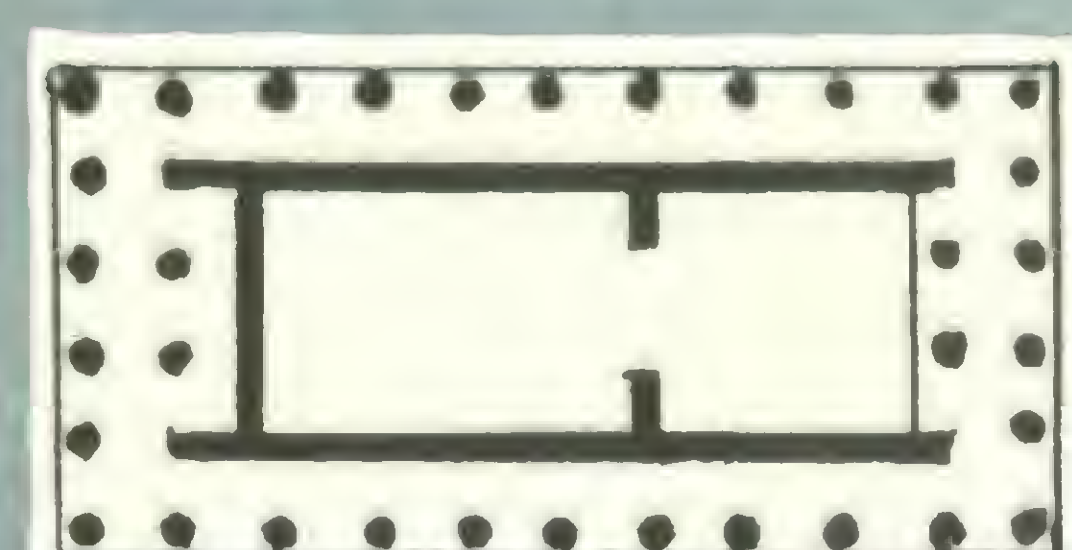
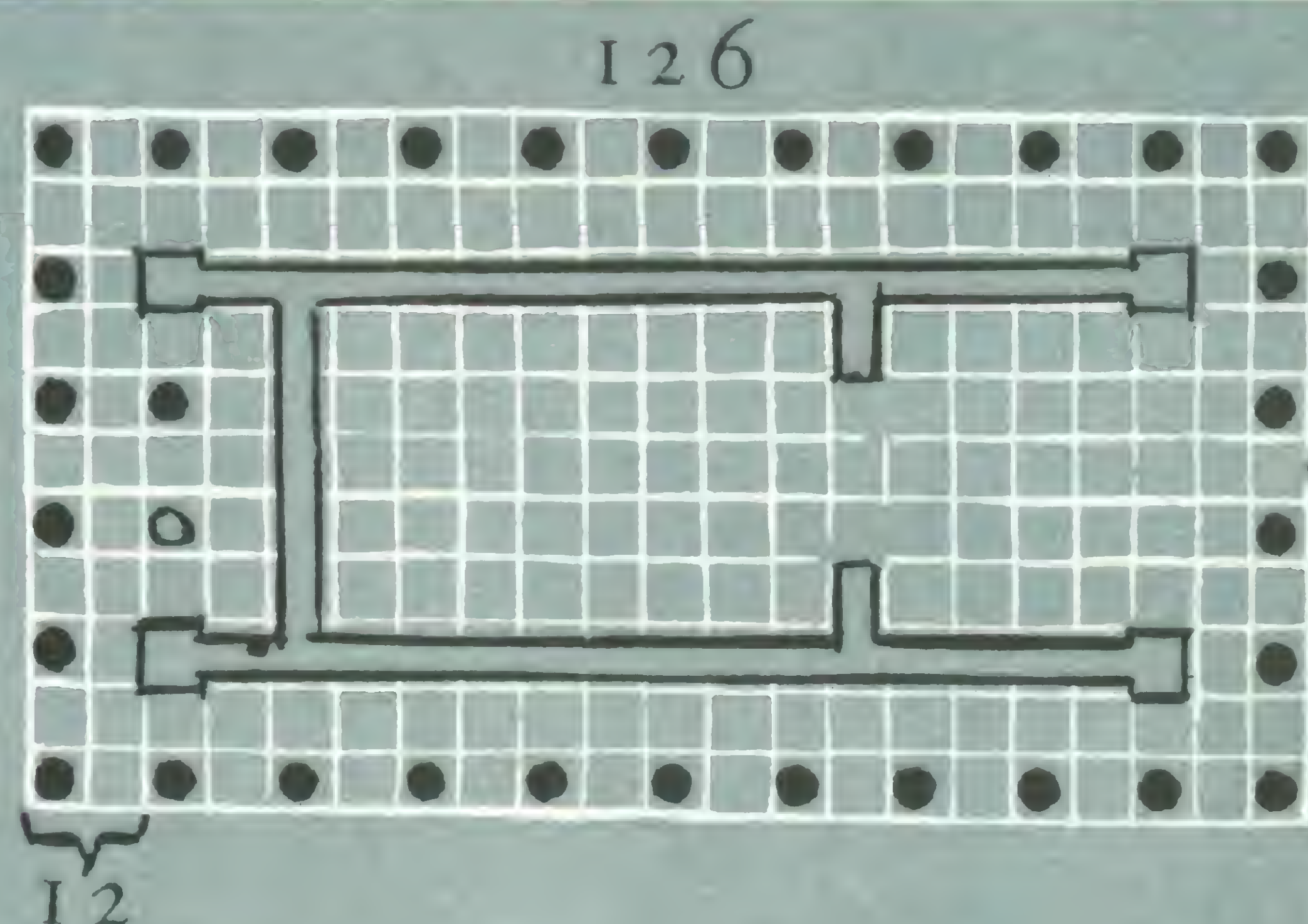
The Doric Temple  
of Athena Alea, Tegea,  
c.353 B.C.

Designed by the sculptor Scopas, the interior  
had 14 Corinthian engaged columns



Doric temple  
of Apollo Epicurius, Bassae, c.430 B.C.

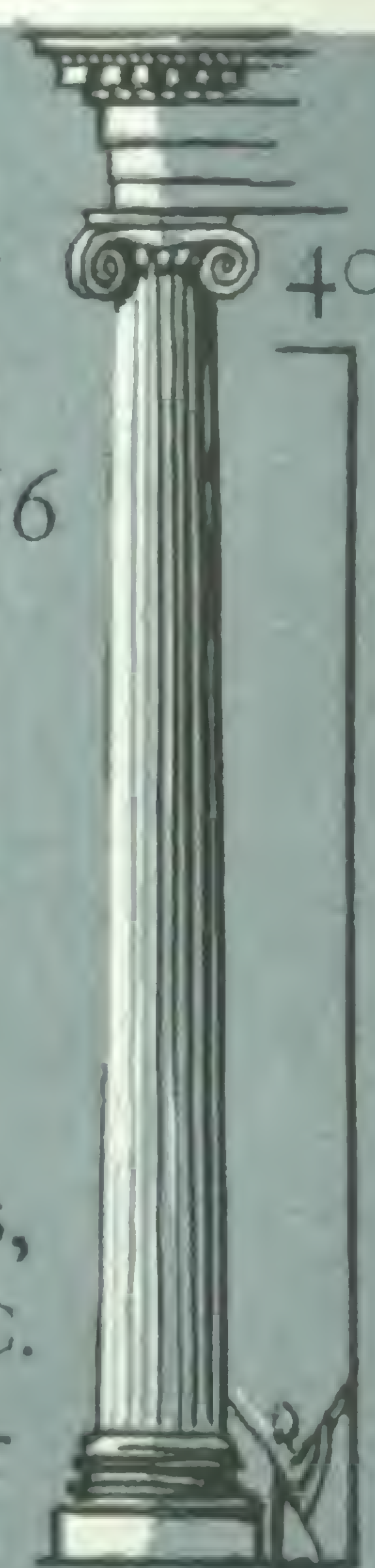
By Ictinus, architect of the Parthenon, Athens.  
The Corinthian order used for the first time  
Built of fine-grained, brittle grey limestone;  
details in marble, roof of thin marble slabs.



Ionic temple  
of Athena Polias,  
Priene, c.334 B.C.

By Pythios, architect and sculptor  
of the Mausoleum, Halicarnassus,  
who wrote a book on the temple, since lost.

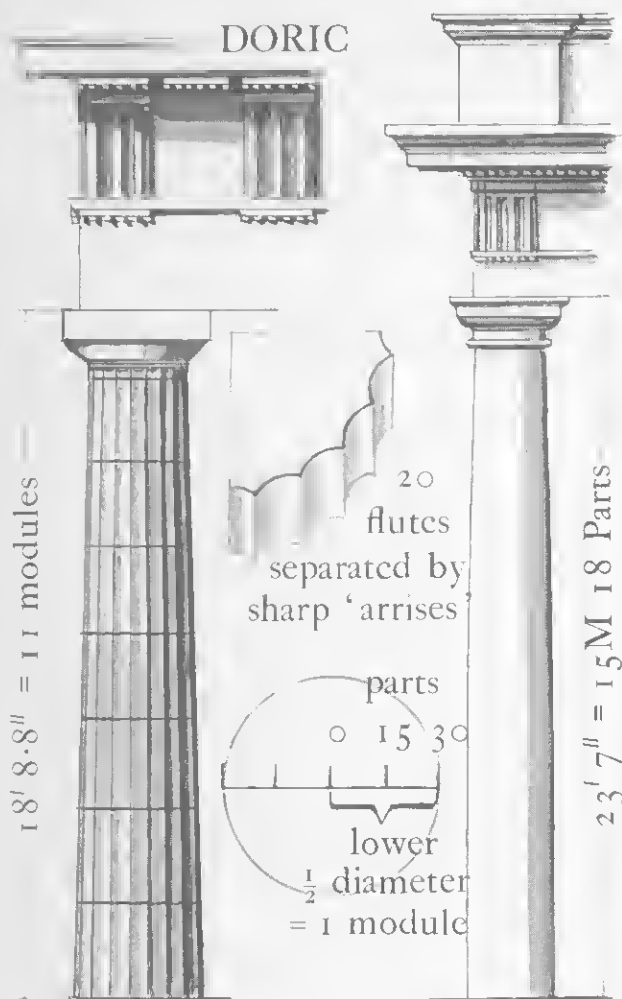
All the measurements are in multiples  
of the Ionic foot, i.e. 11.587 inches.





# GREEK & ROMAN

DORIC



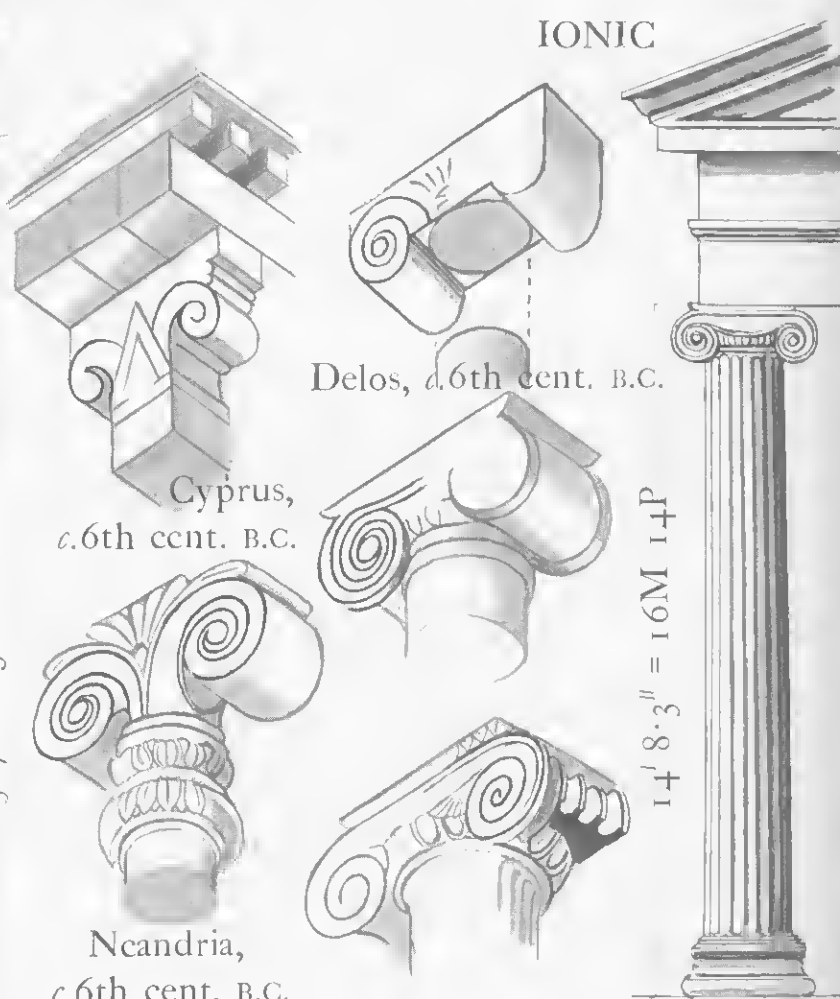
Greek

The Theseion,  
Athens

Roman

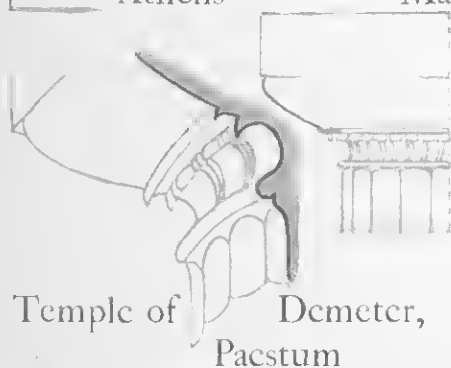
Theatre of  
Marcellus, Rome

IONIC

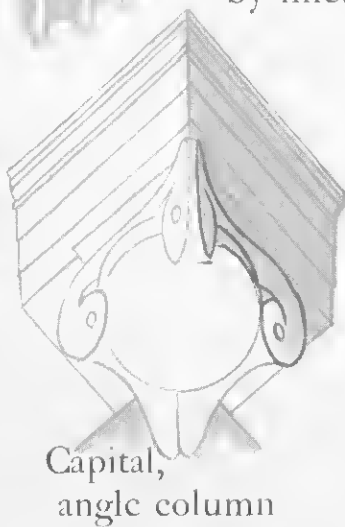


Greek

Temple on the  
Ilissus, Athens



Ionic and  
Corinthian;  
24 flutes  
separated  
by fillets



Temple of Aphaia, Aegina

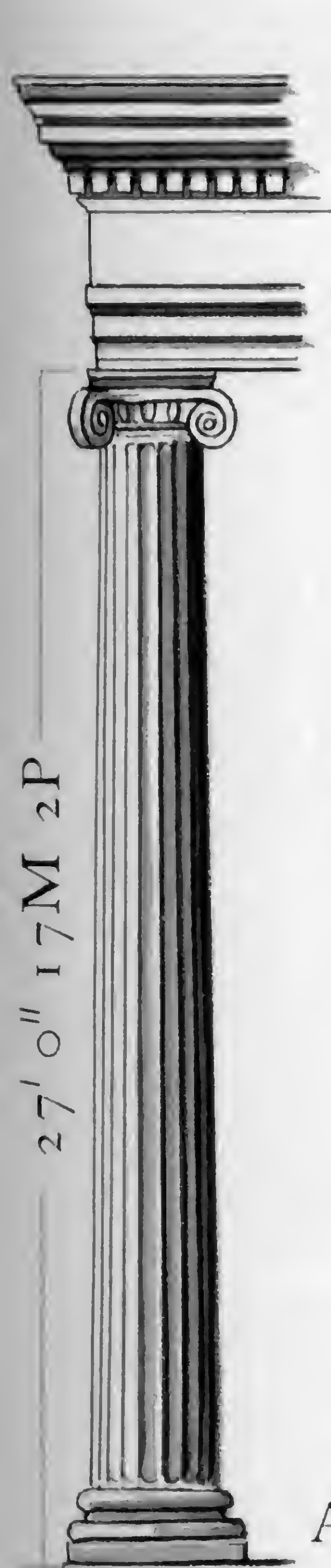


# THE FIVE ORDERS

CORINTHIAN

COMPO-  
SITE

TUSCAN

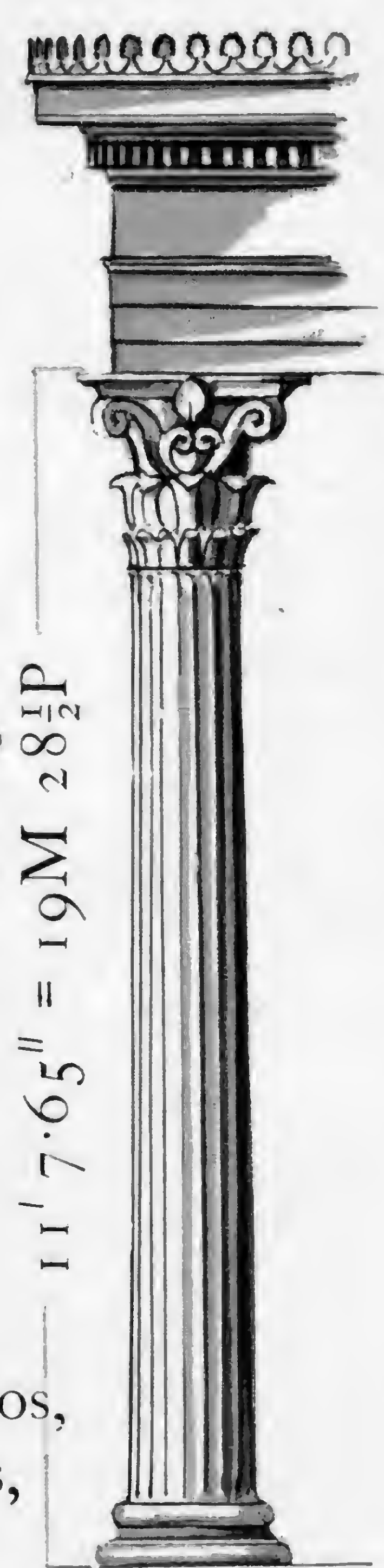


Egypt, Dynasty XIX



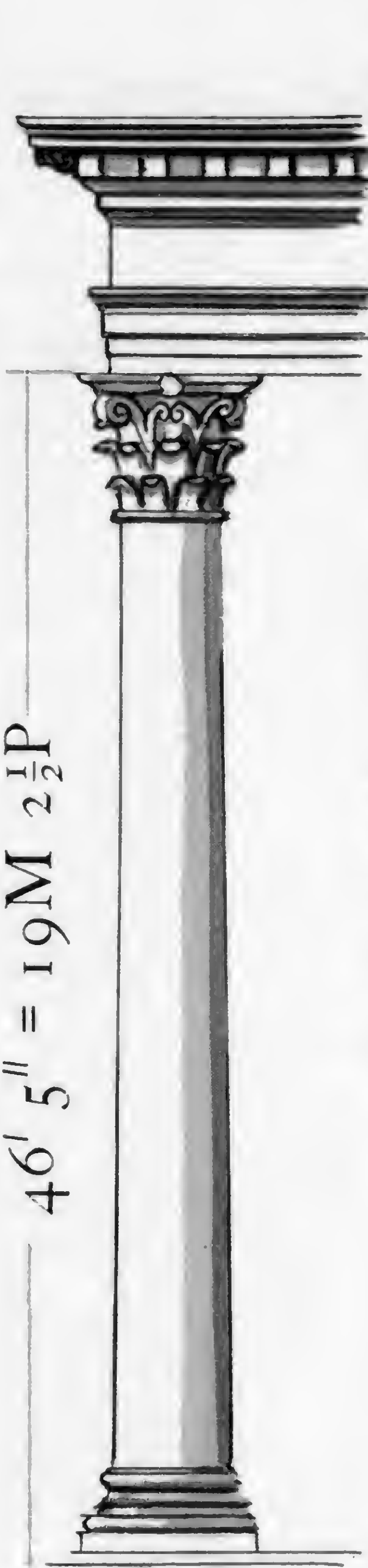
Tower of  
the Winds,  
Athens, c. 334

The Tholos,  
Epidauros,  
c. 360 B.C.



Greek

Choragic  
Monument, Athens



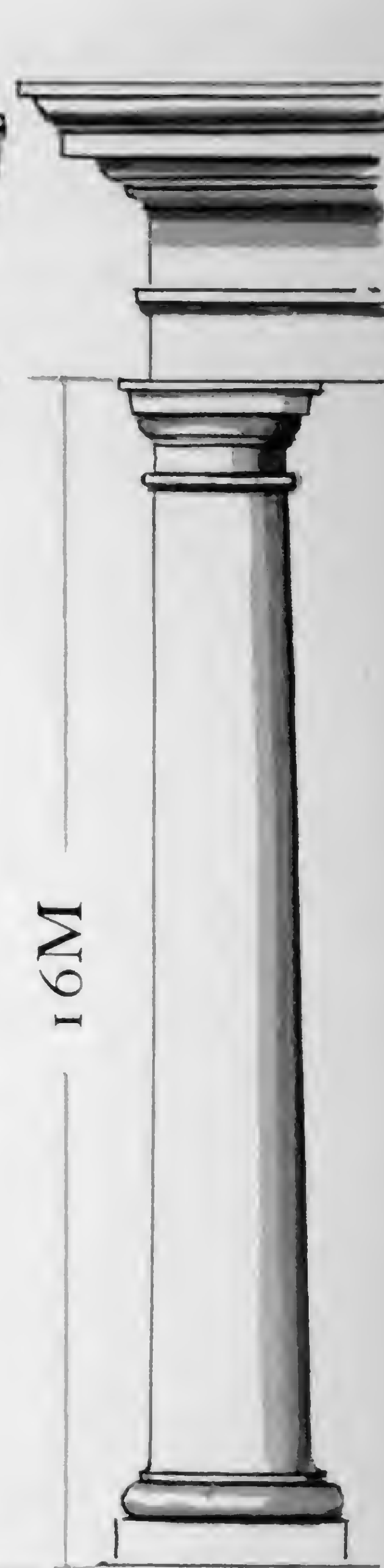
Roman

The Pantheon.  
Rome



Roman

Arch of  
Severus, Rome

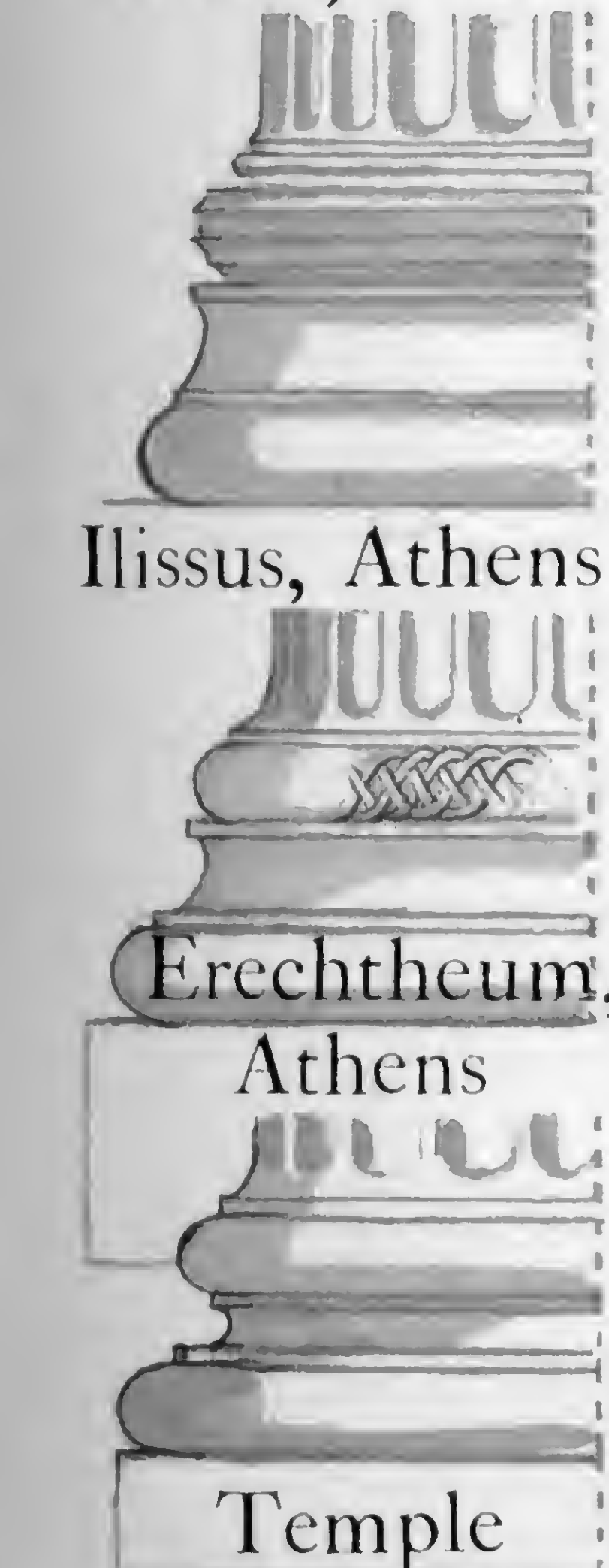


Roman

Vitruvius  
(IV, 7)

Roman

Temple Fortuna  
Virilis, Rome



Ilissus, Athens



Erechtheum,  
Athens

Temple  
Fortuna Virilis,  
Rome



The Olympieum,  
Athens, c. 174 B.C.  
Capitals taken  
to Rome, 86 B.C.



Temple of  
Castor and Pollux,  
Rome, A.D. 16



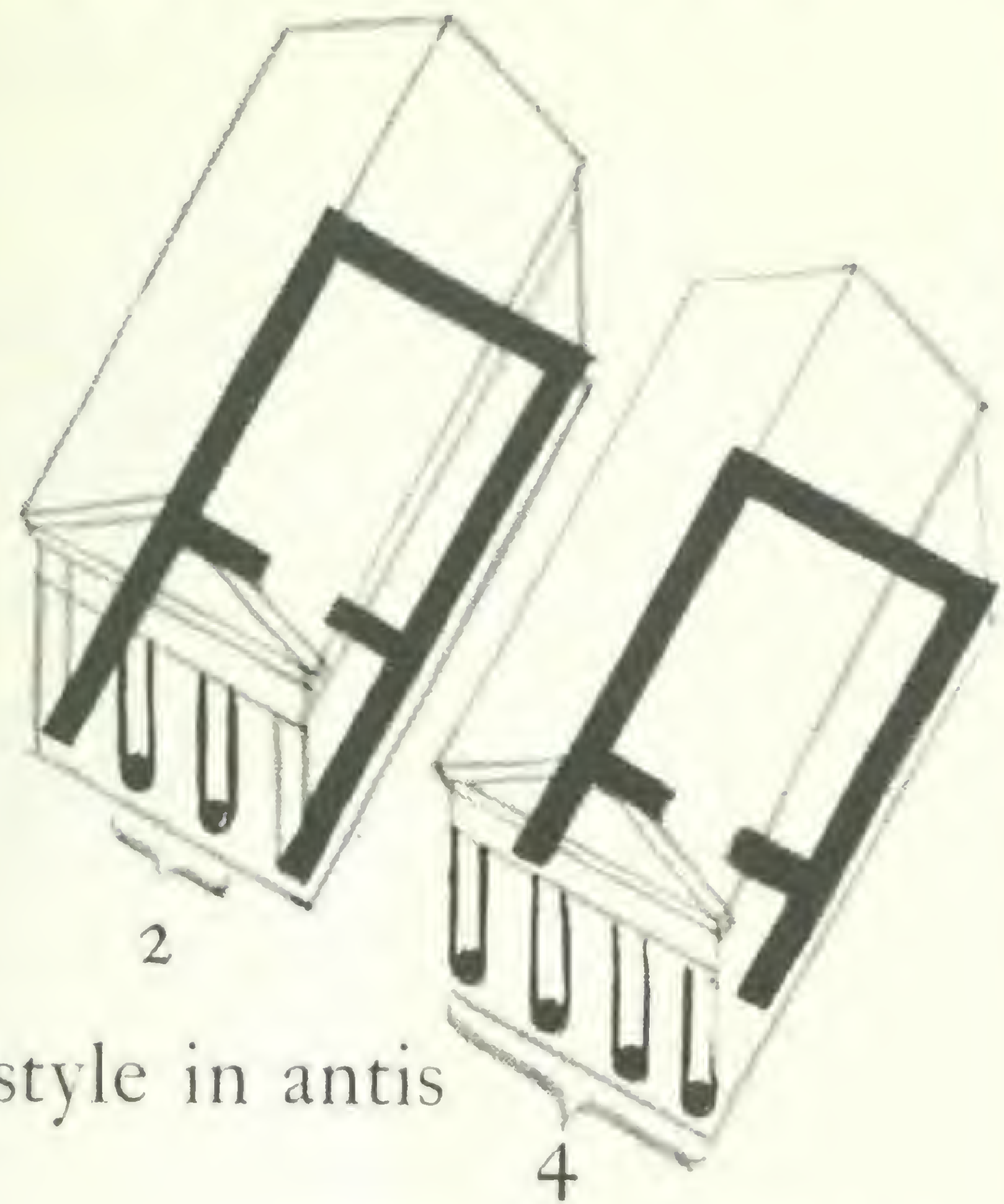
Arch of  
Titus,  
Rome, A.D. 81



From  
*The Five Orders  
of Architecture*  
by Vignola  
(A.D. 1509-73)



# GREEK



2

4

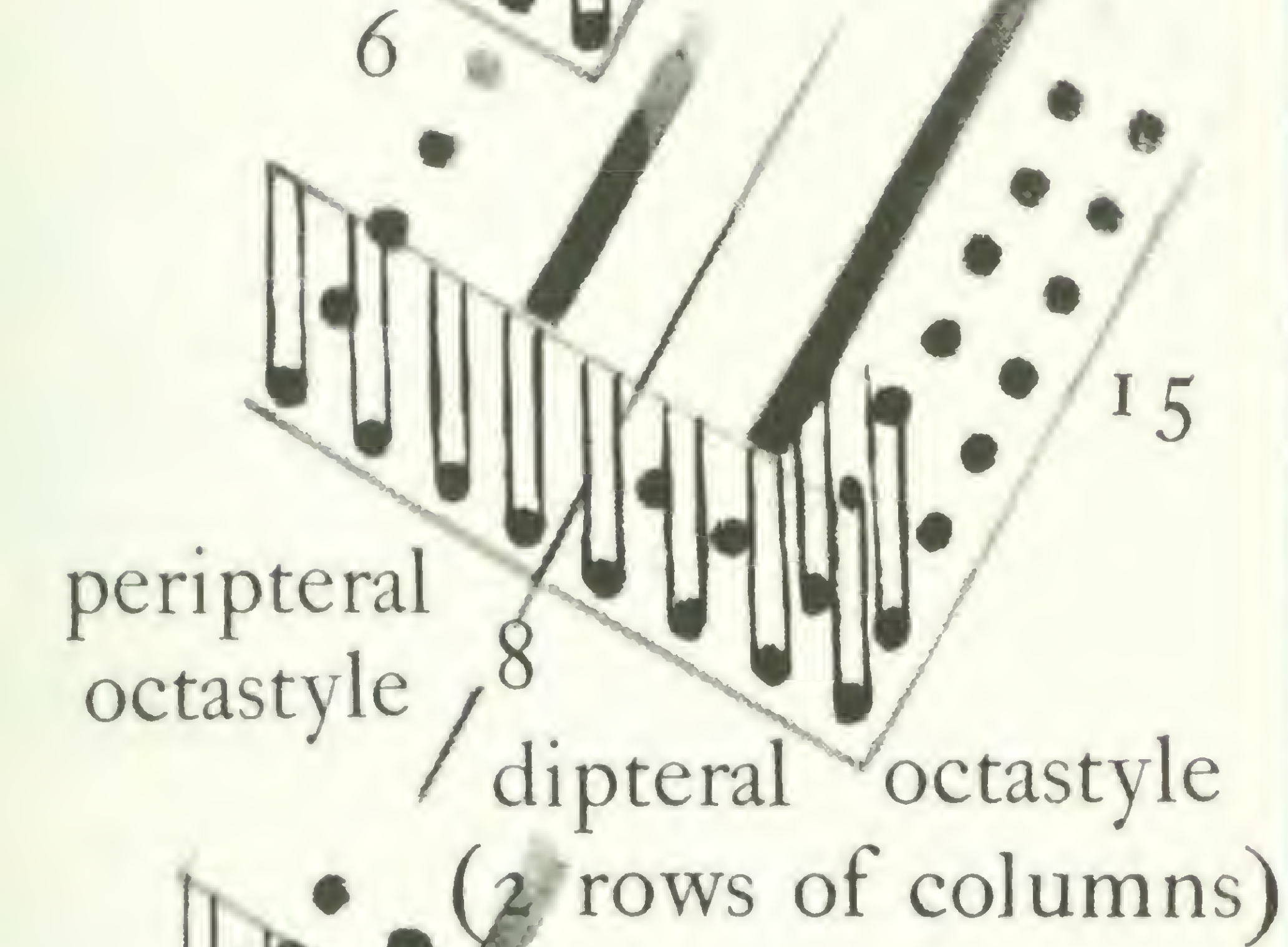
distyle in antis

prostyle tetrastyle



11

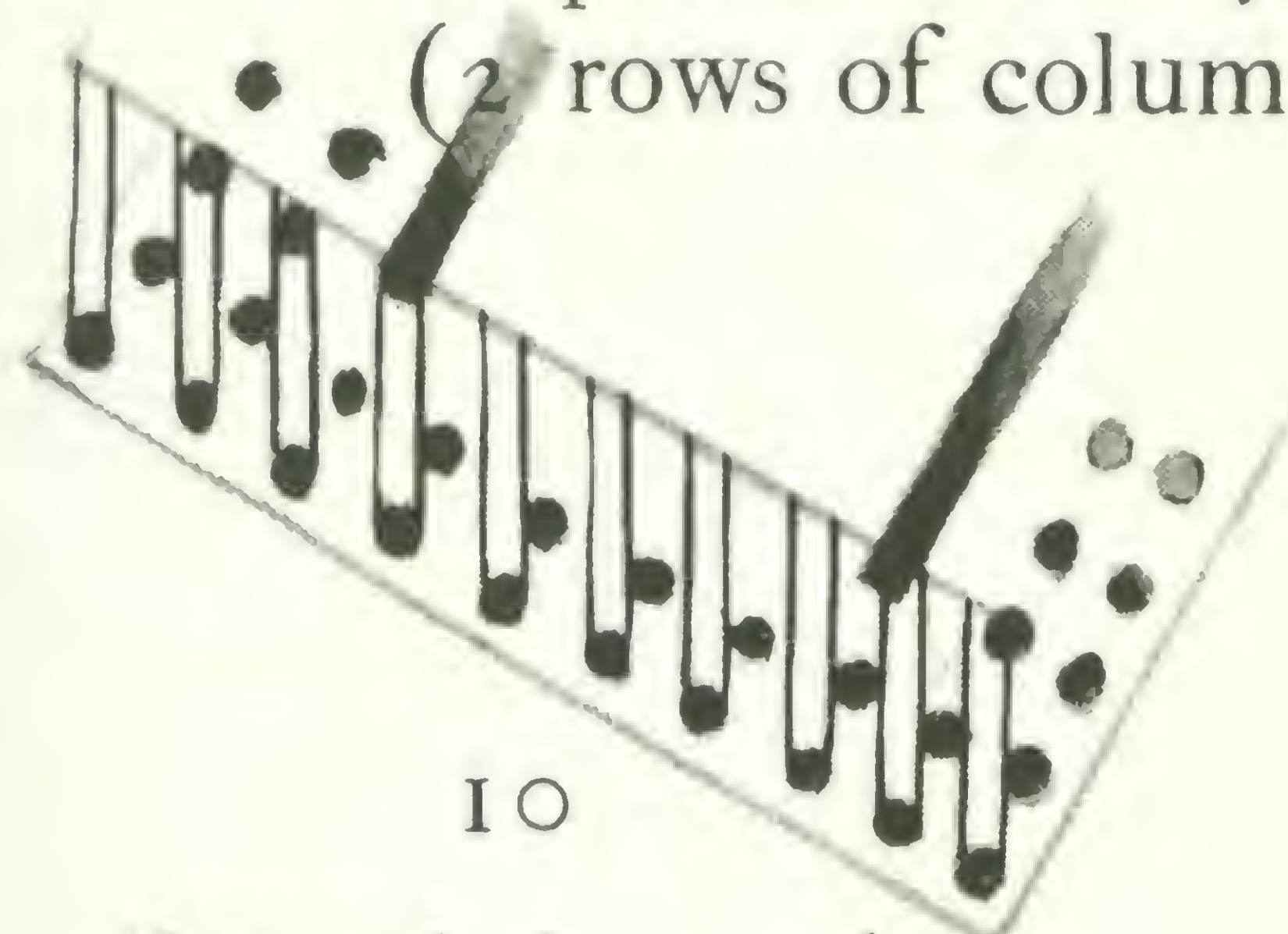
6



15

peripteral octastyle

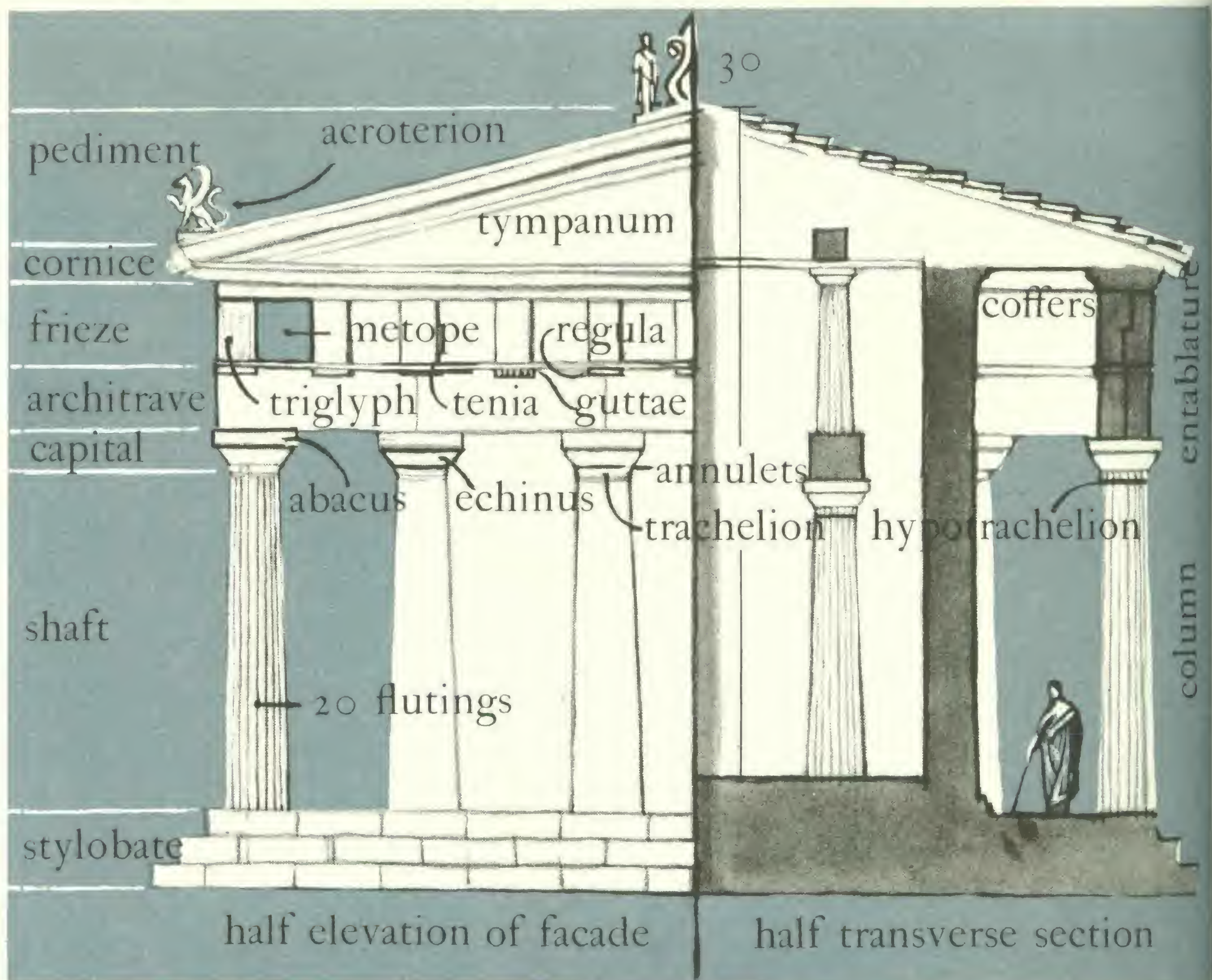
dipteral octastyle (2 rows of columns)



10

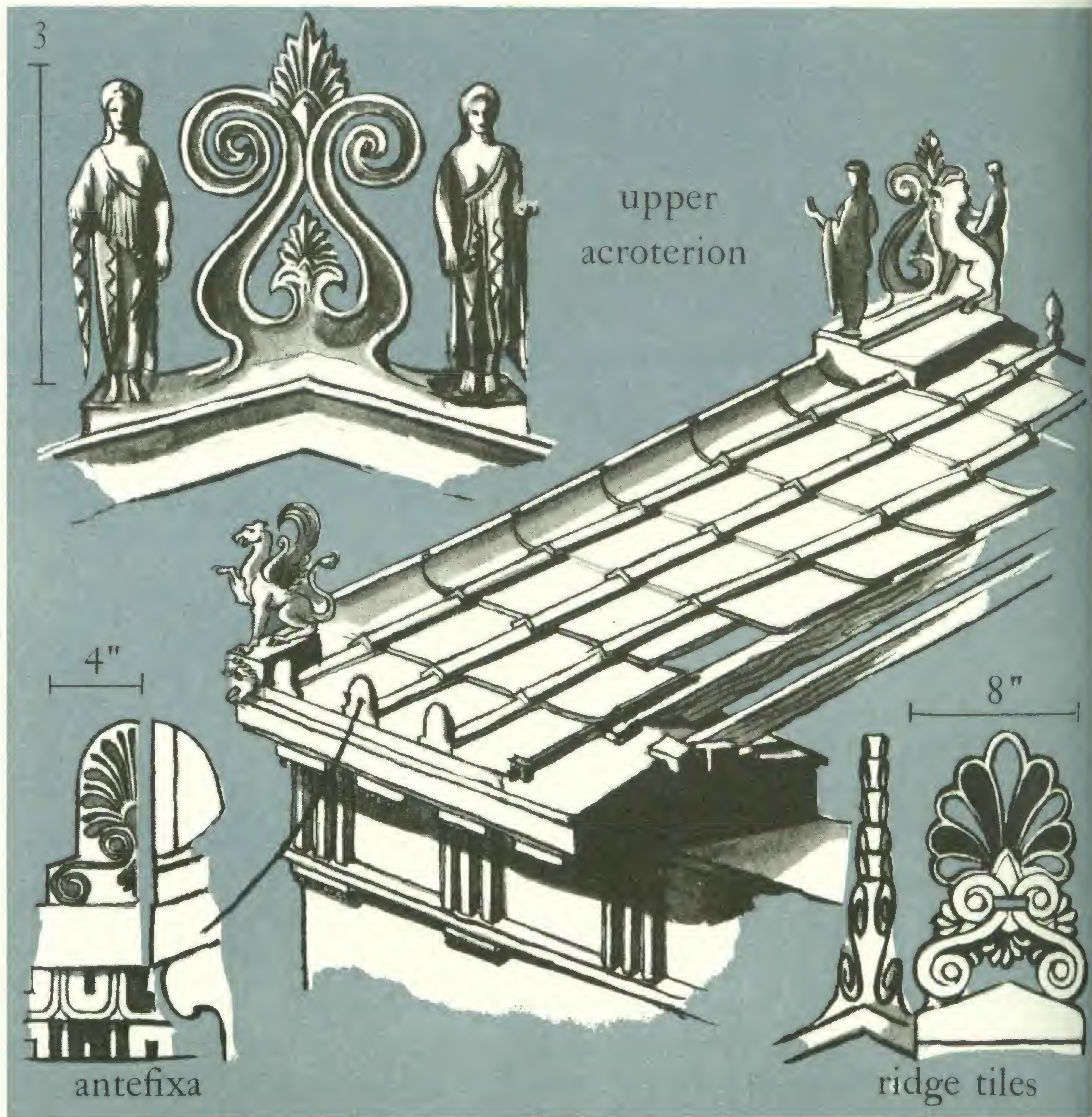
dipteral decastyle

Classification of columnan arrangement according to Vitruvius (I 11, 2)



half elevation of facade

half transverse section



upper acroterion

4"

8"

antefixa

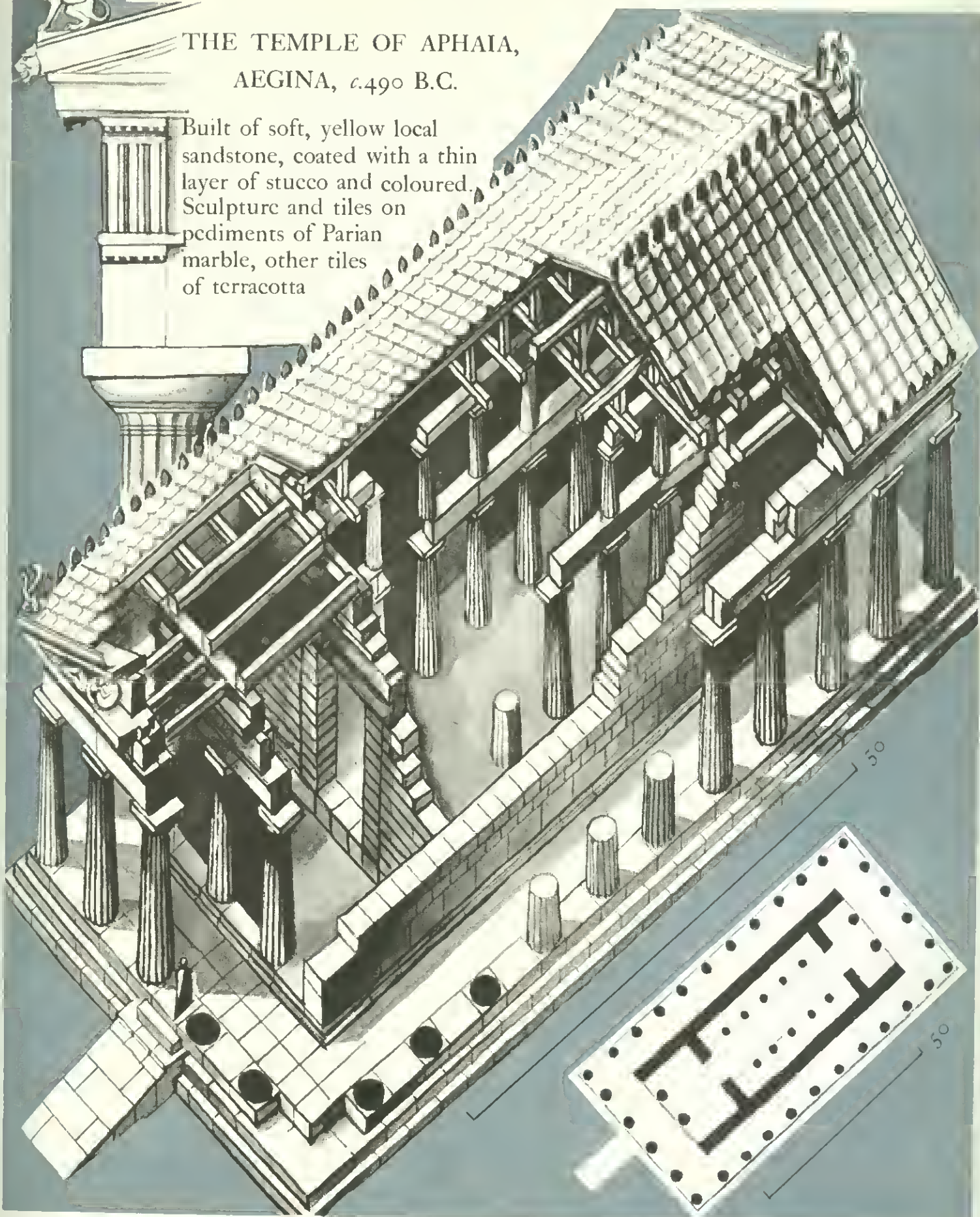
ridge tiles



# THE DORIC TEMPLE

## THE TEMPLE OF APHAIA, AEGINA, c.490 B.C.

Built of soft, yellow local sandstone, coated with a thin layer of stucco and coloured. Sculpture and tiles on pediments of Parian marble, other tiles of terracotta





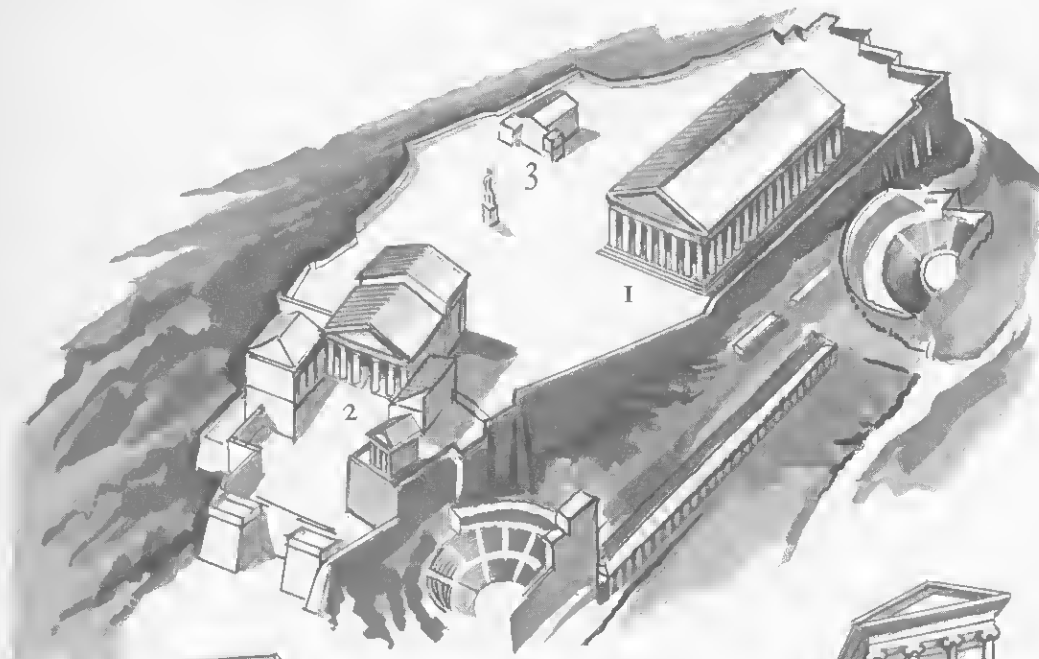
# GREEK

# ATHENS,

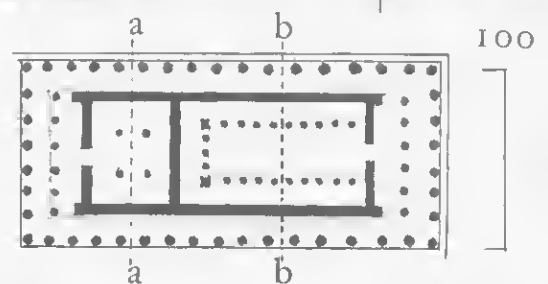
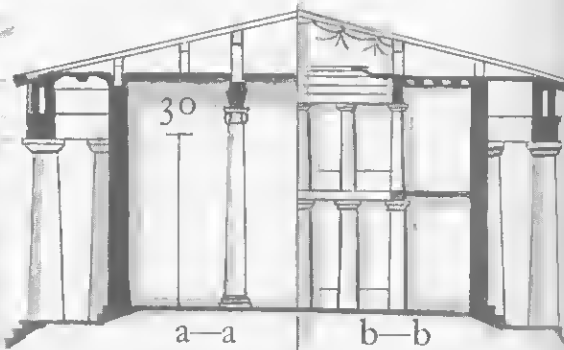
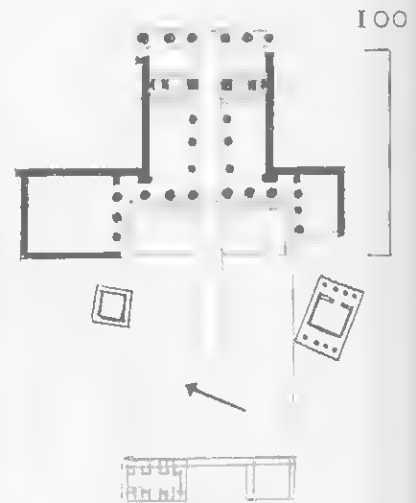
Between the Greeks' defeat of the Persians in 479 B.C. and the Peloponnesian War (431-404 B.C.)

Athens rose to her zenith, under the leadership of Pericles buildings were erected on the Acropolis:

- 1 The Parthenon
- 2 The Propylaea
- 3 The Erechtheum (restored)



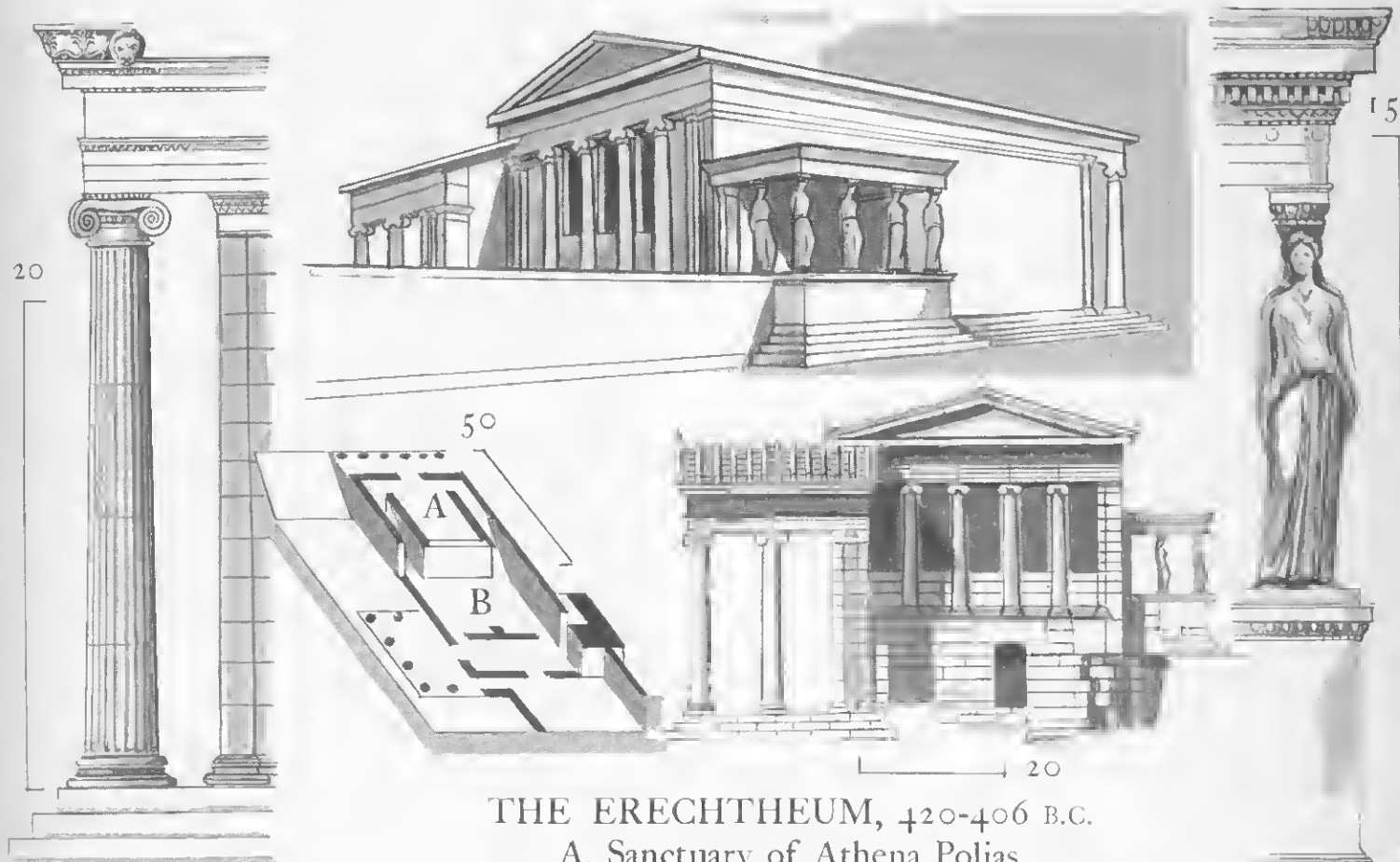
THE PROPYLAEA, entrance to the Acropolis, 437-432 B.C. Mnesicles, architect. Built of marble



THE PARTHENON, 447-432 B.C. Doric temple dedicated to Athena. Ictinus and Callicrates, architects; Phidias, master sculptor. Optical refinements p. 38



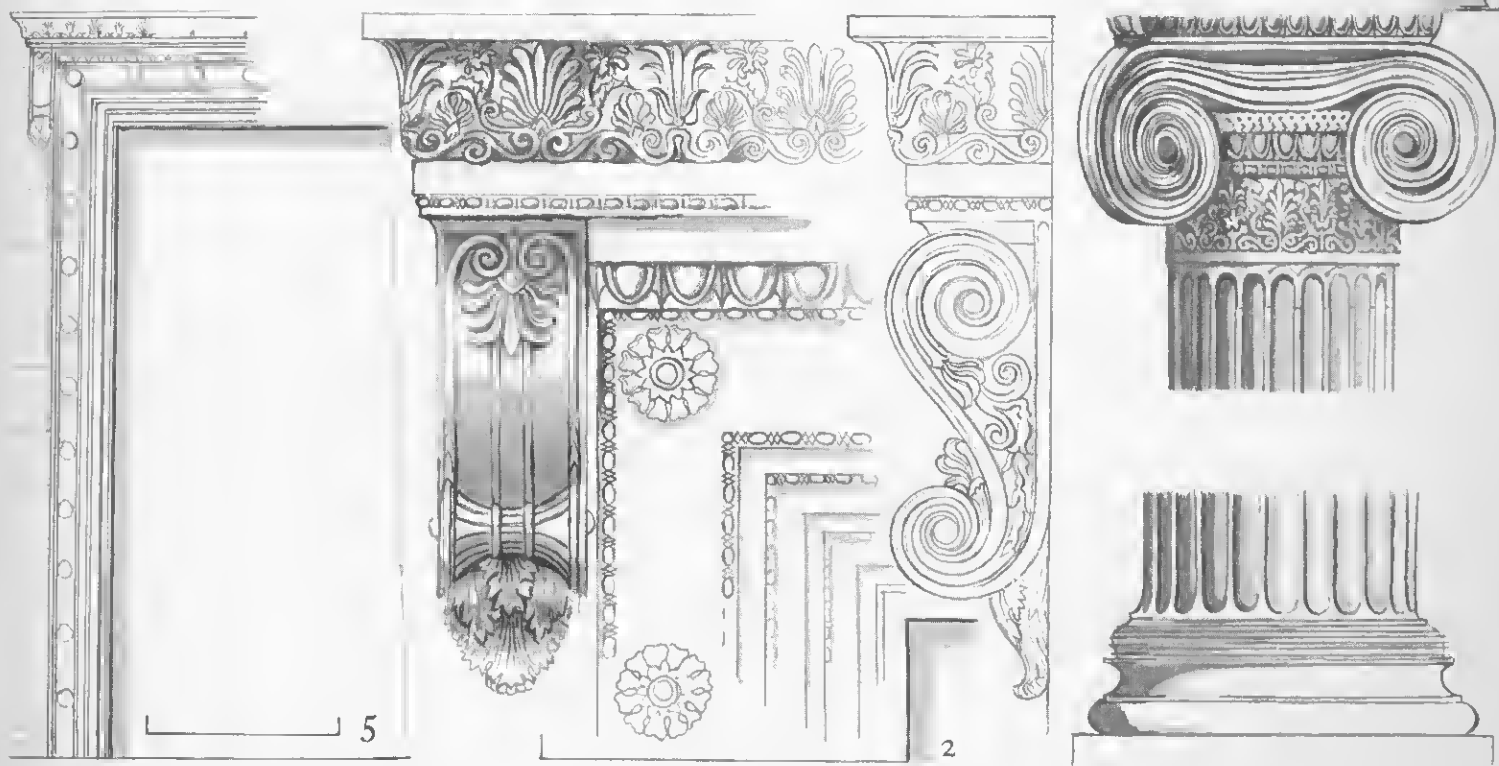
# BUILDINGS ON THE ACROPOLIS



THE ERECHTHEUM, 420-406 B.C.

A. Sanctuary of Athena Polias

B. Sanctuaries of Erechtheus and Poseidon



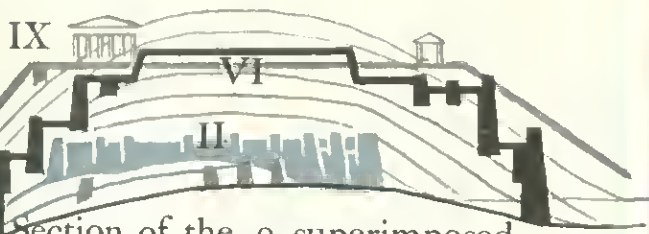
Possible architect Mnesicles. The caryatids and column capitals may have been designed by Callimachus, inventor of the Corinthian capital. Built on 4 levels, irregular in plan to preserve places sacred to Athens; built of white marble



# GREEK

# CITY

## AEGEAN

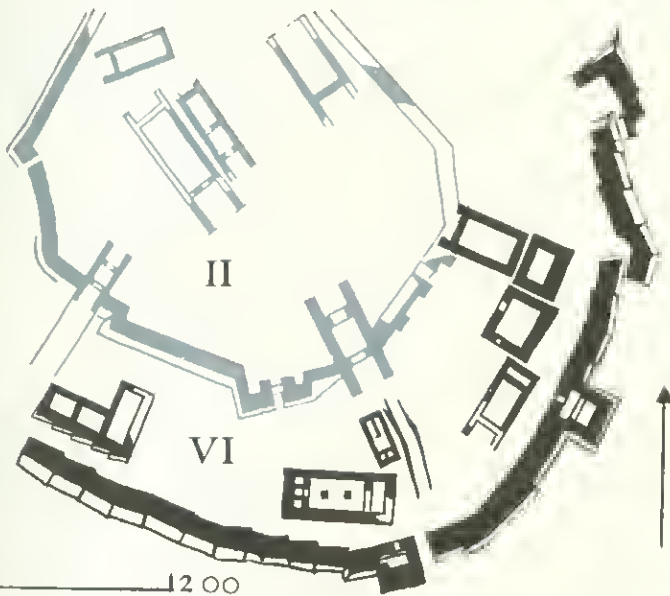


Section of the 9 superimposed  
'cities' of TROY

II Prehistoric citadel, c.2600-2300 B.C.

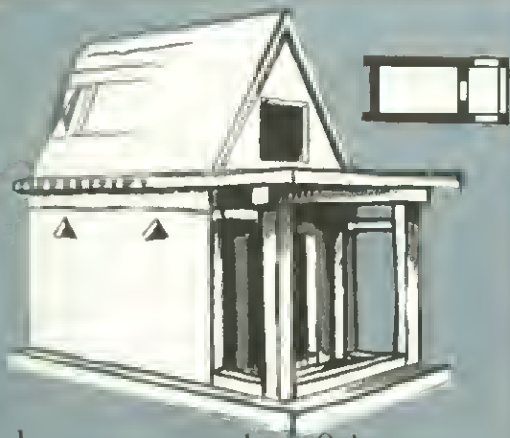
VI Homeric Troy, 1900 B.C.; sacked c.1200 B.C.

IX The Roman acropolis, c.30 B.C.-A.D. 14.



Plan of selected buildings, Troy

II Prehistoric citadel VI Homeric Troy



A house or temple, c.8th cent. B.C.  
after a terracotta model  
from Argive Heraeum

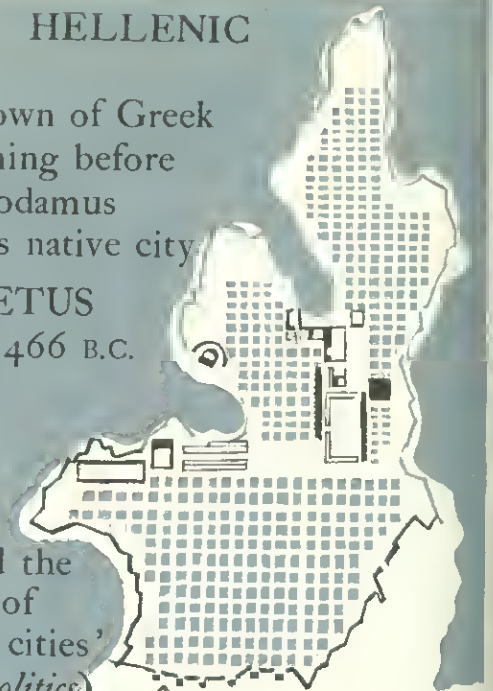
## HELLENIC

Little is known of Greek  
city planning before  
Hippodamus  
laid out his native city

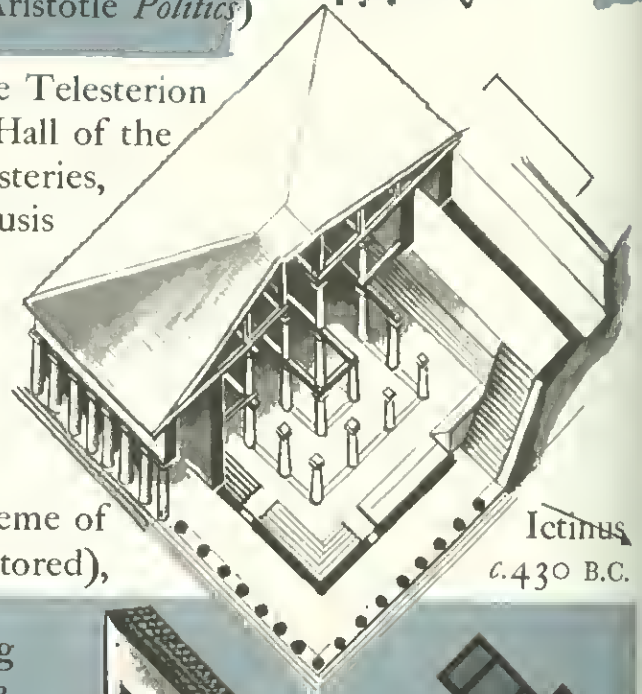
### MILETUS

c.479 or 466 B.C.

and  
'discovered the  
method of  
dividing up cities'  
(Aristotle *Politics*)



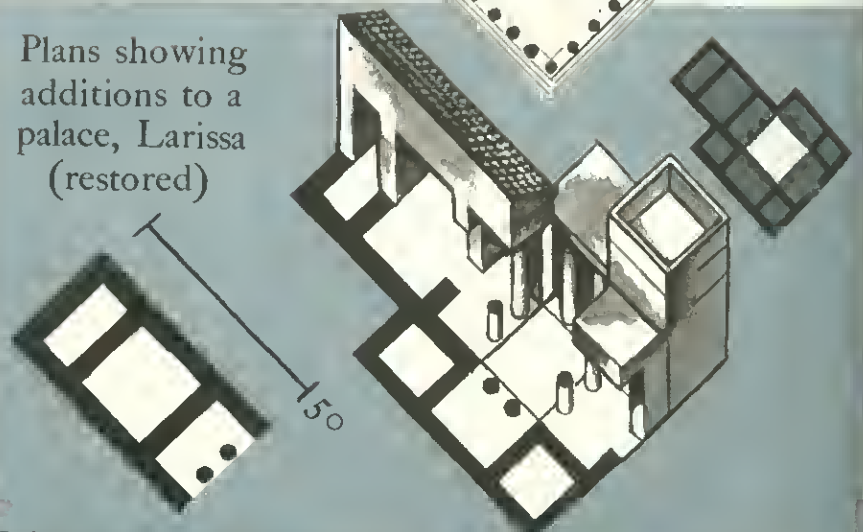
The Telesterion  
or Hall of the  
Mysteries,  
Eleusis



Scheme of  
(restored),

Ictinus  
c.430 B.C.

Plans showing  
additions to a  
palace, Larissa  
(restored)



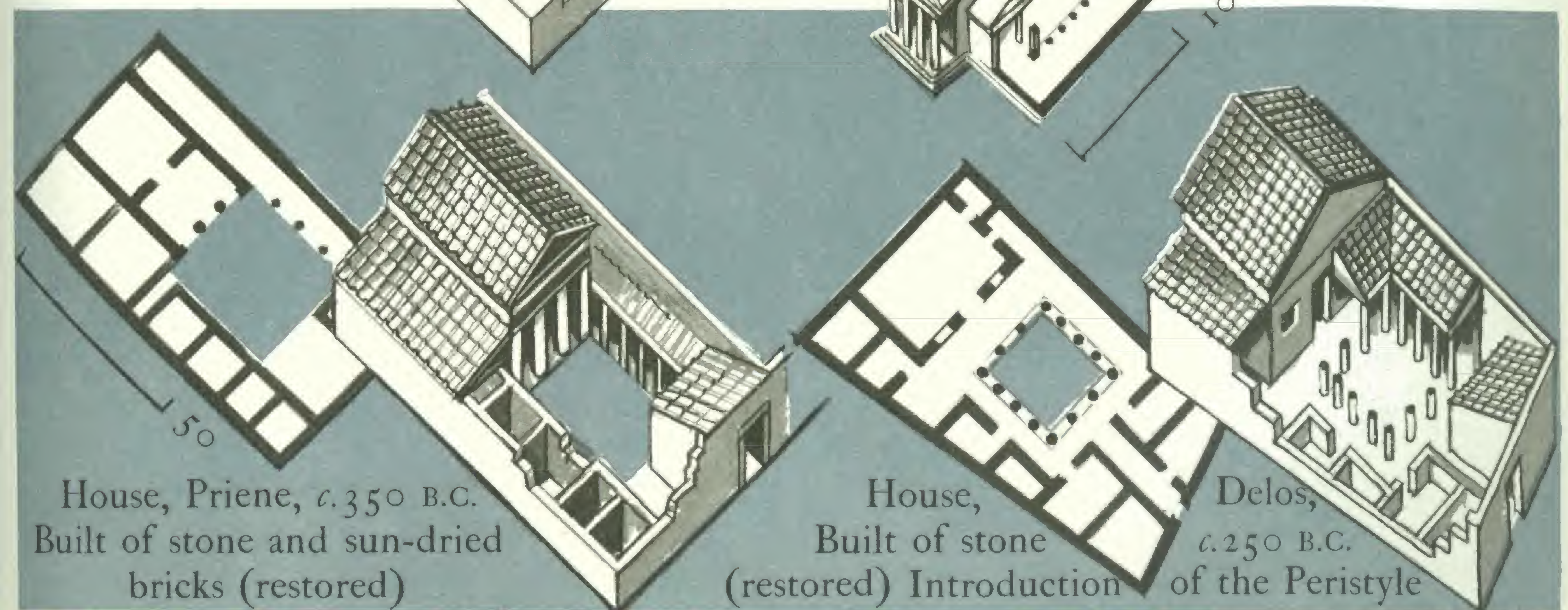
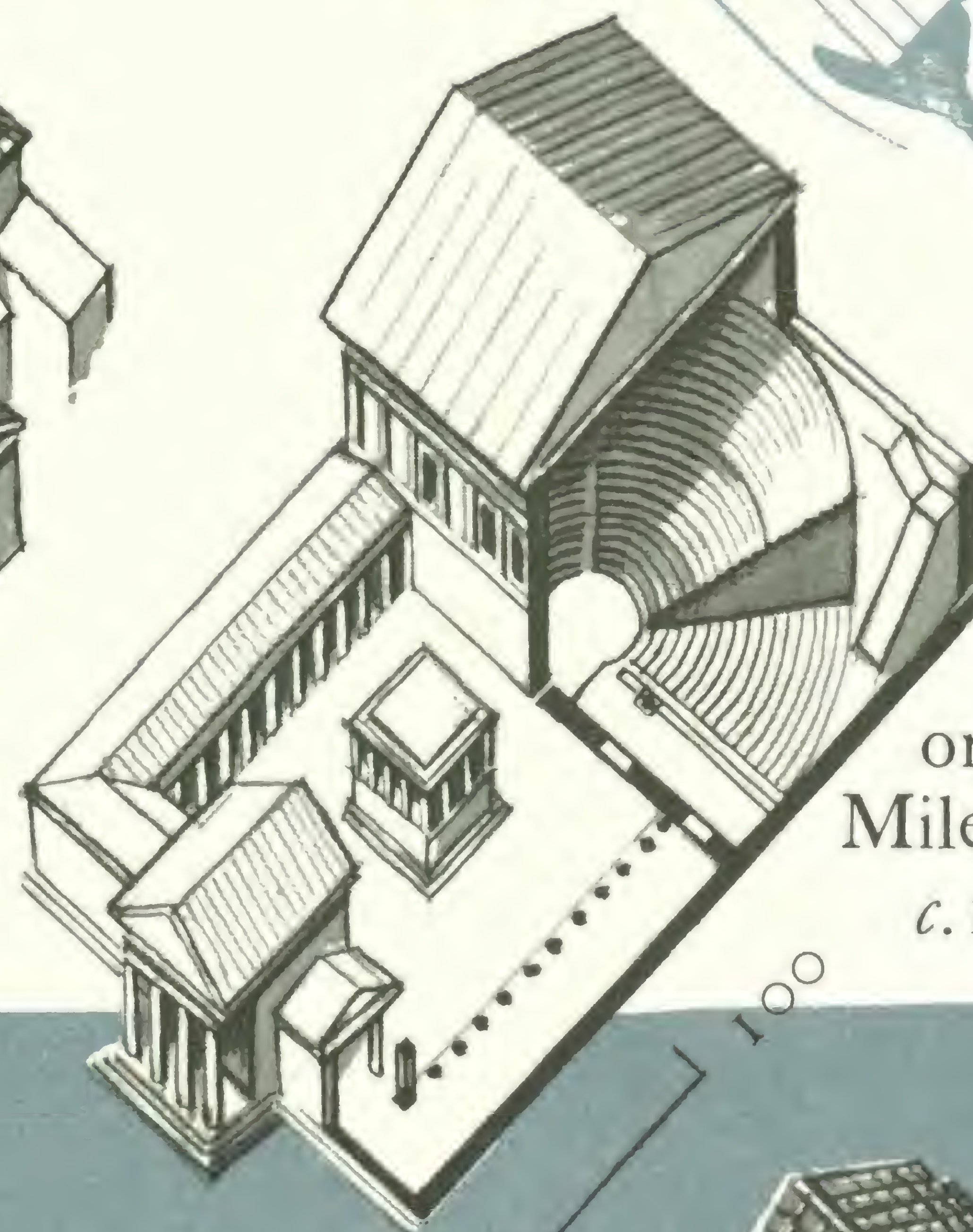
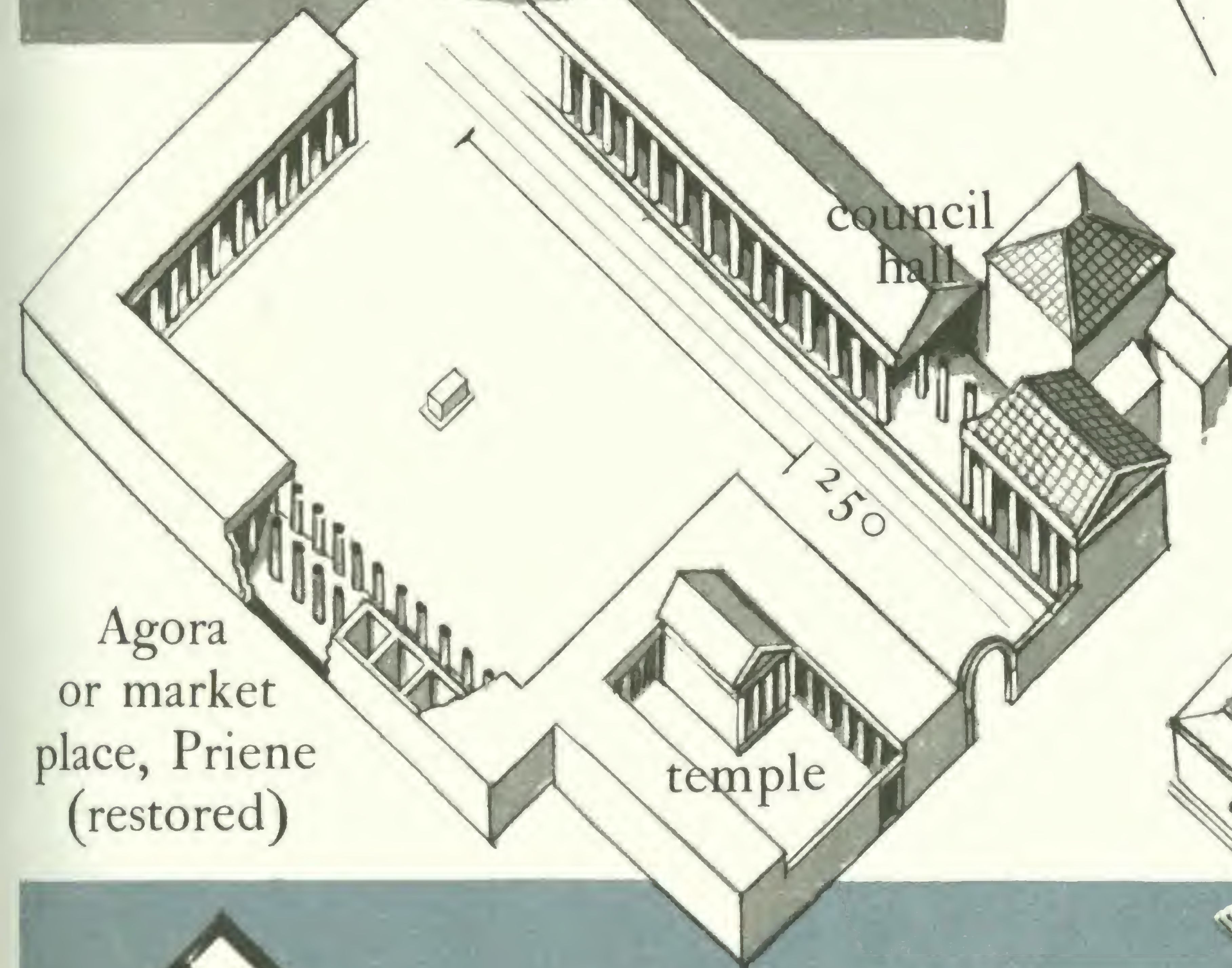
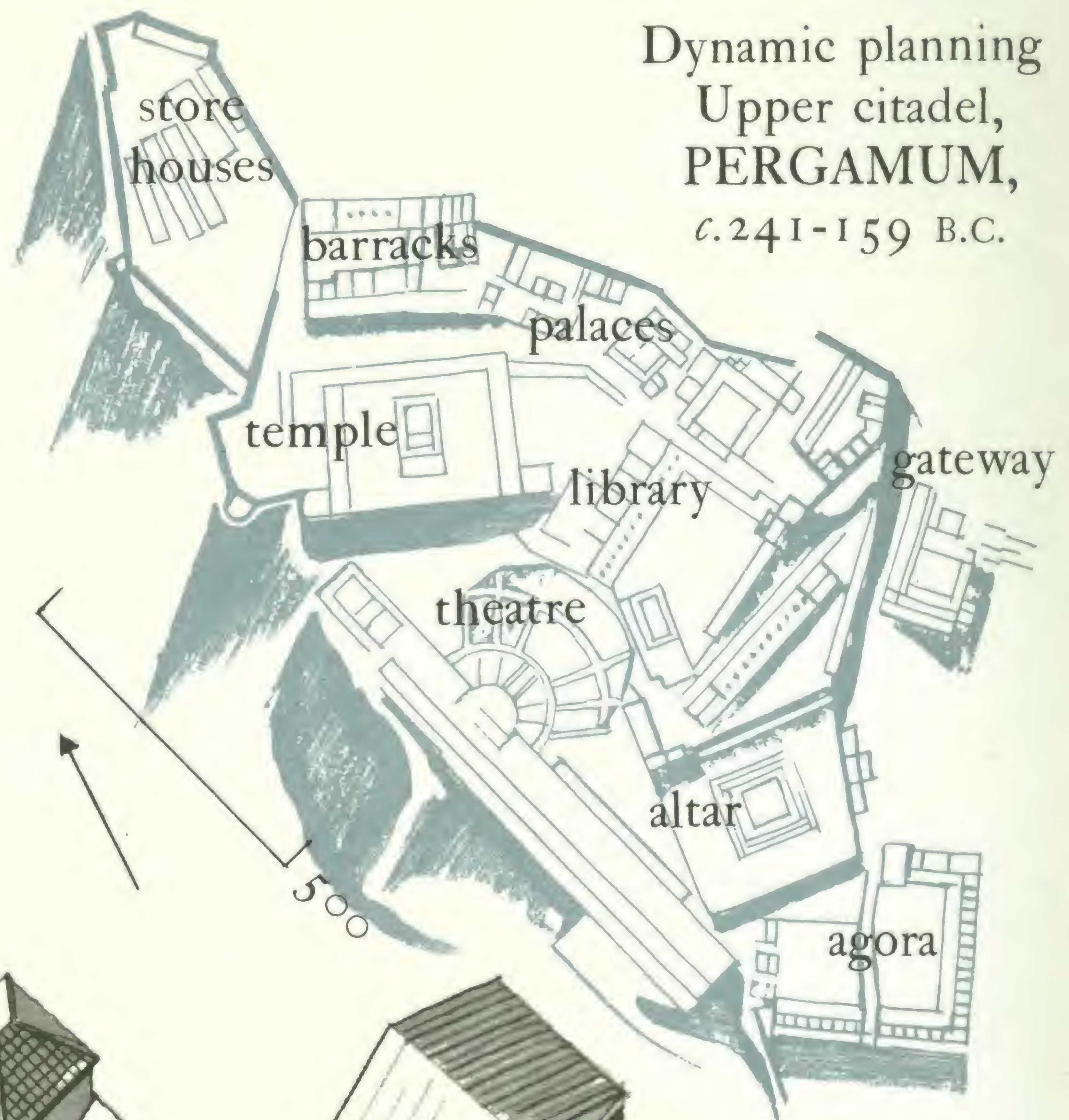
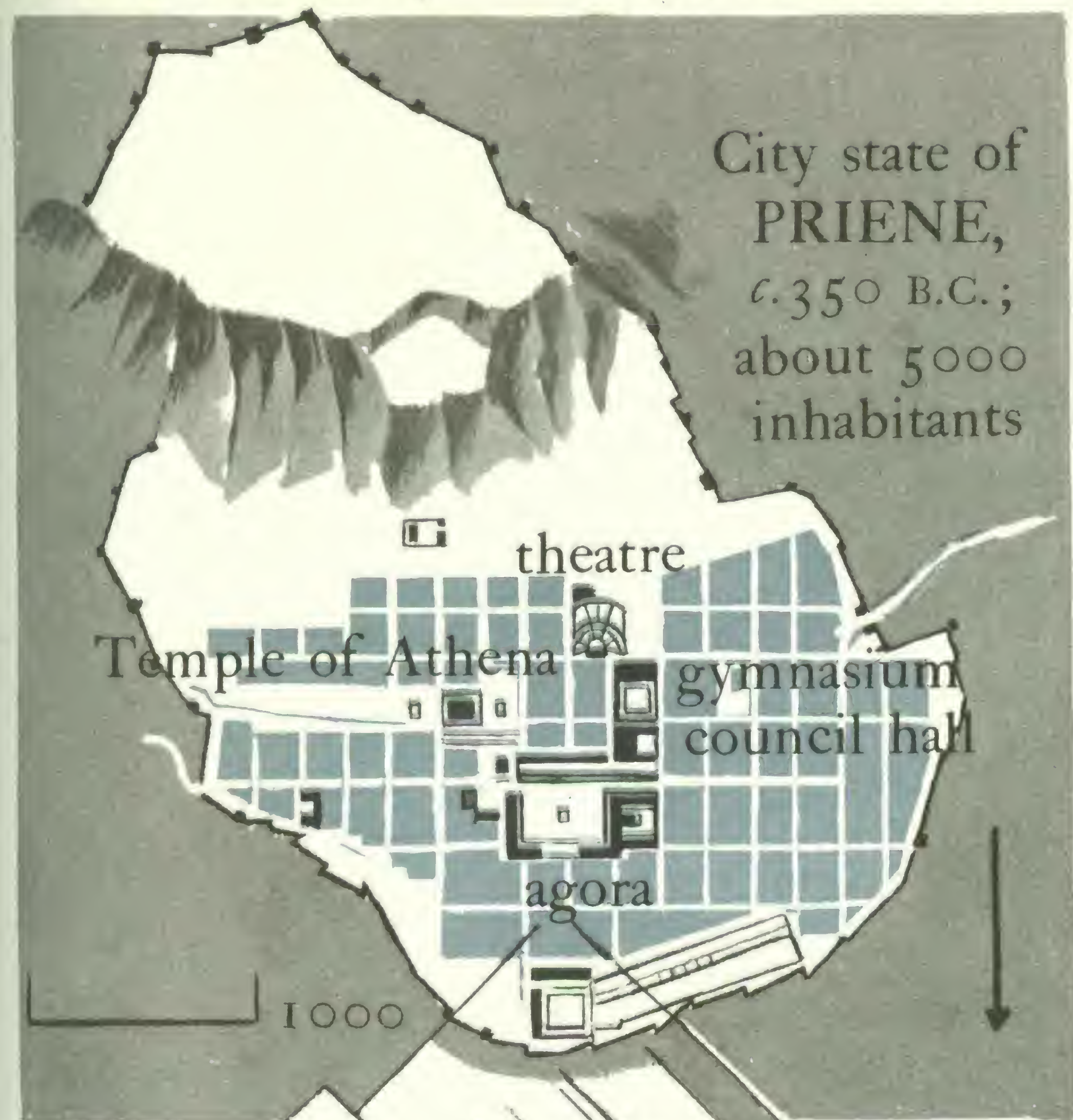
Megaron, c.500 B.C.

Peristyle, c.450 B.C.



# PLANS, BUILDINGS AND HOUSES

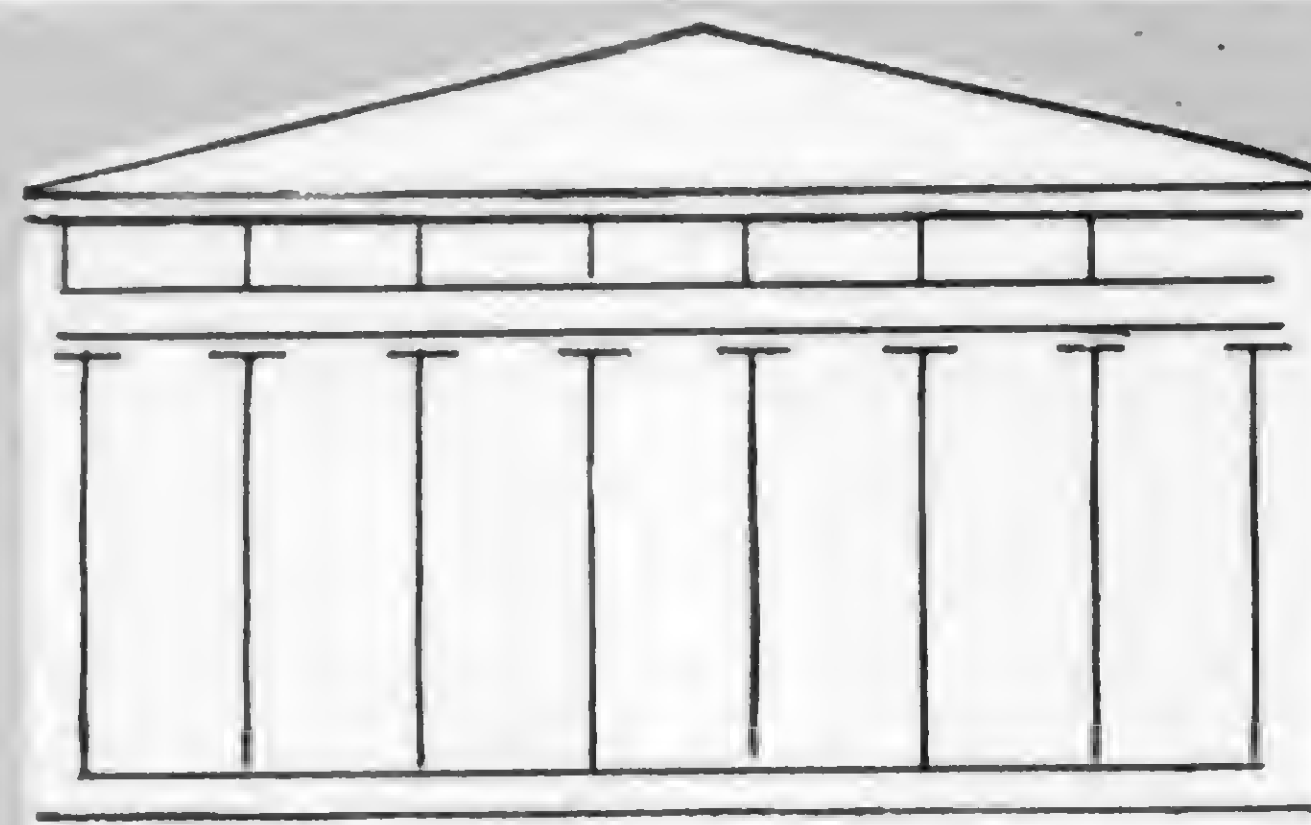
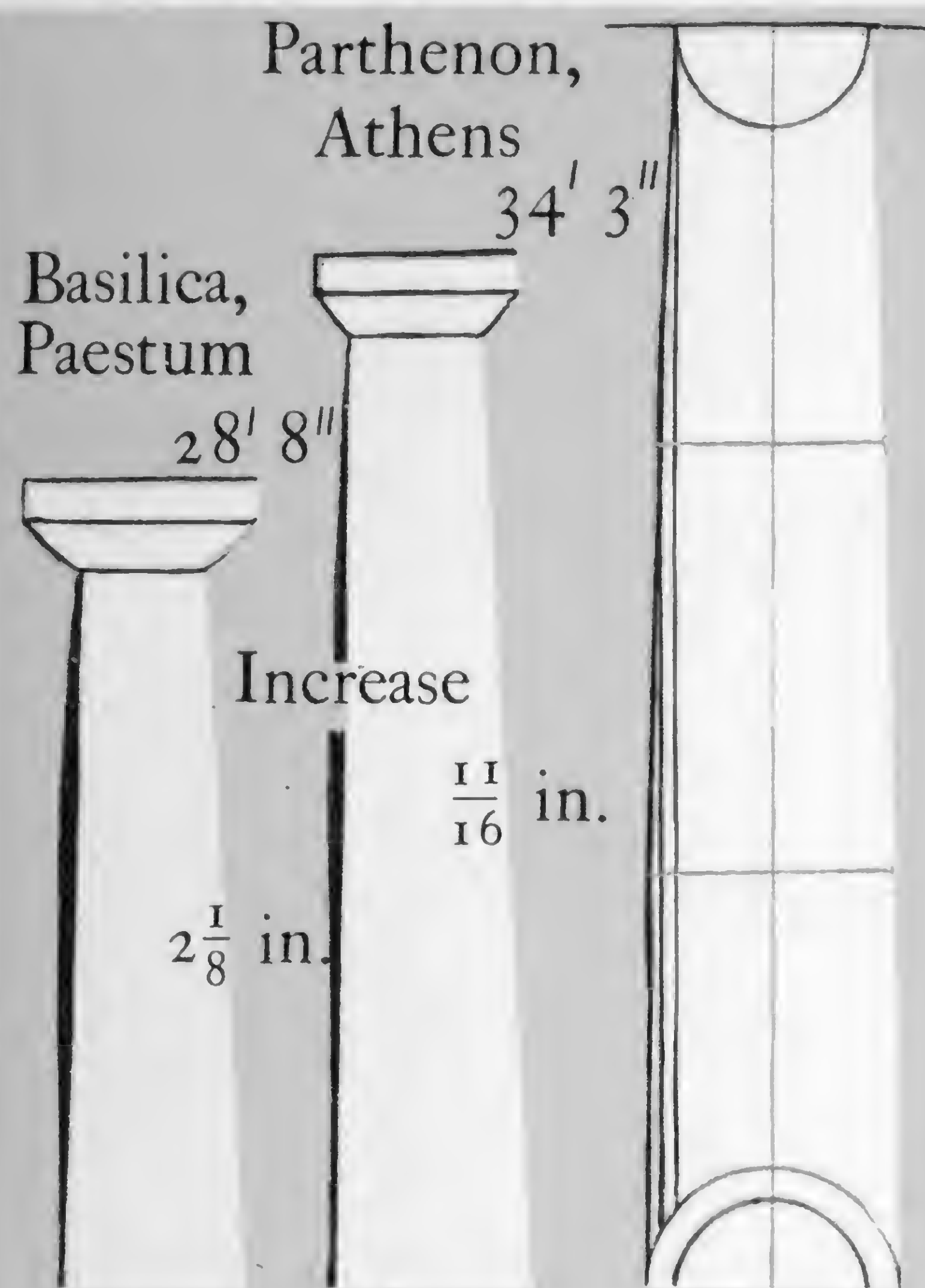
## HELLENISTIC



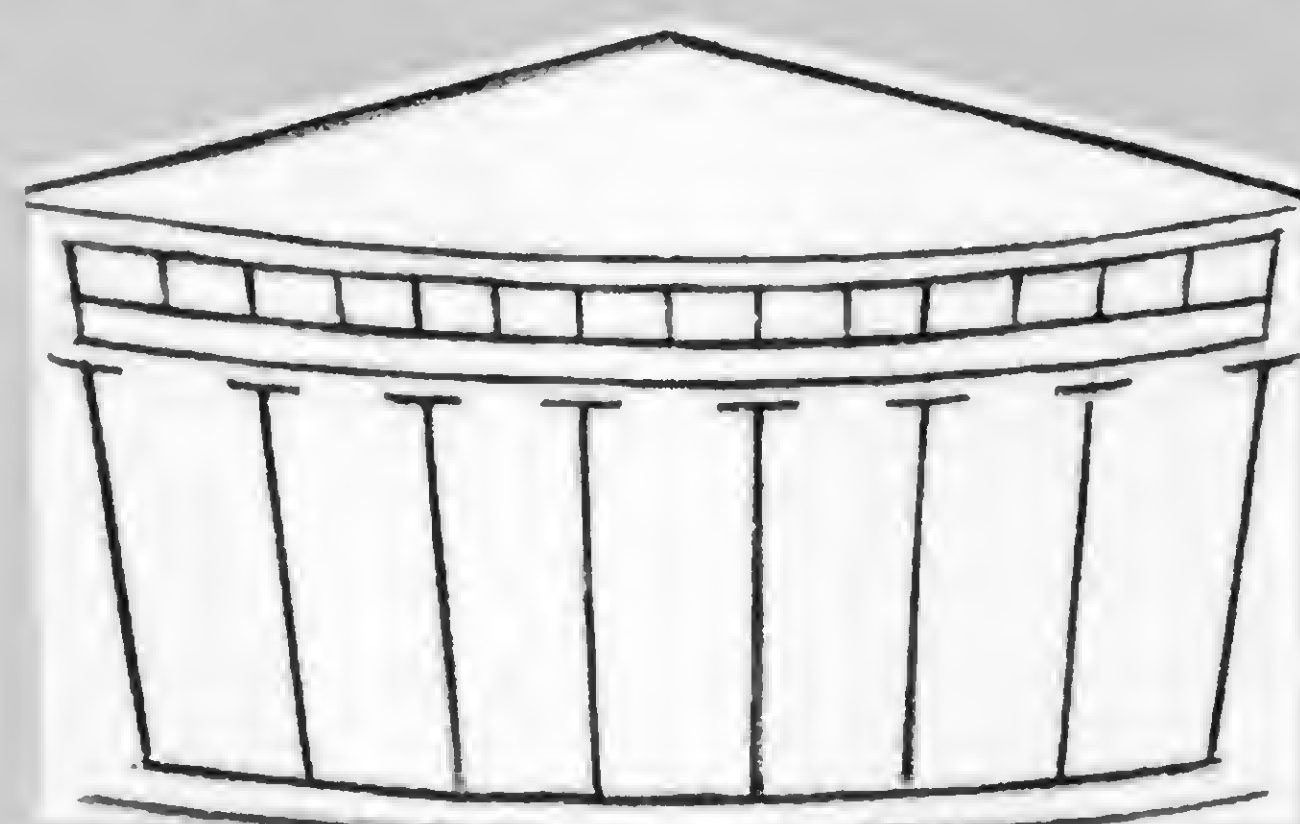


# GREEK

# REFINEMENTS



1 The Parthenon as seen

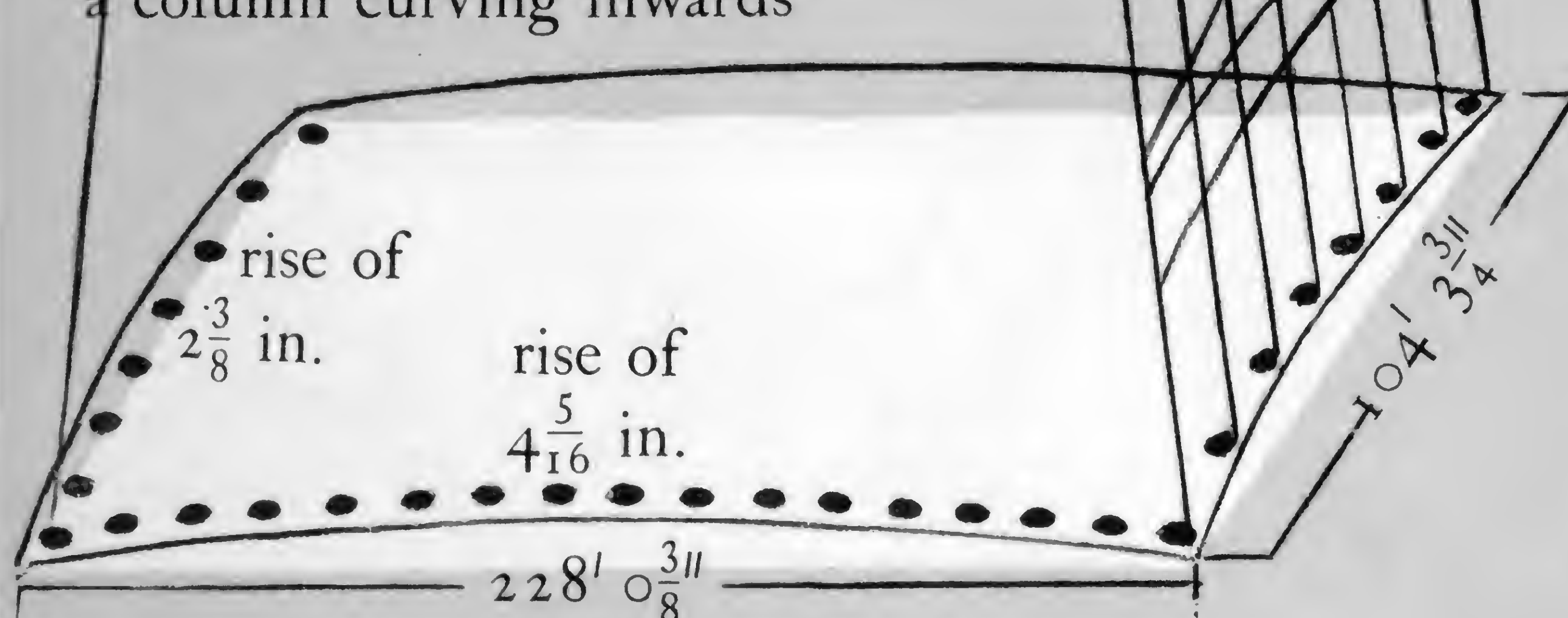


2 Without optical corrections

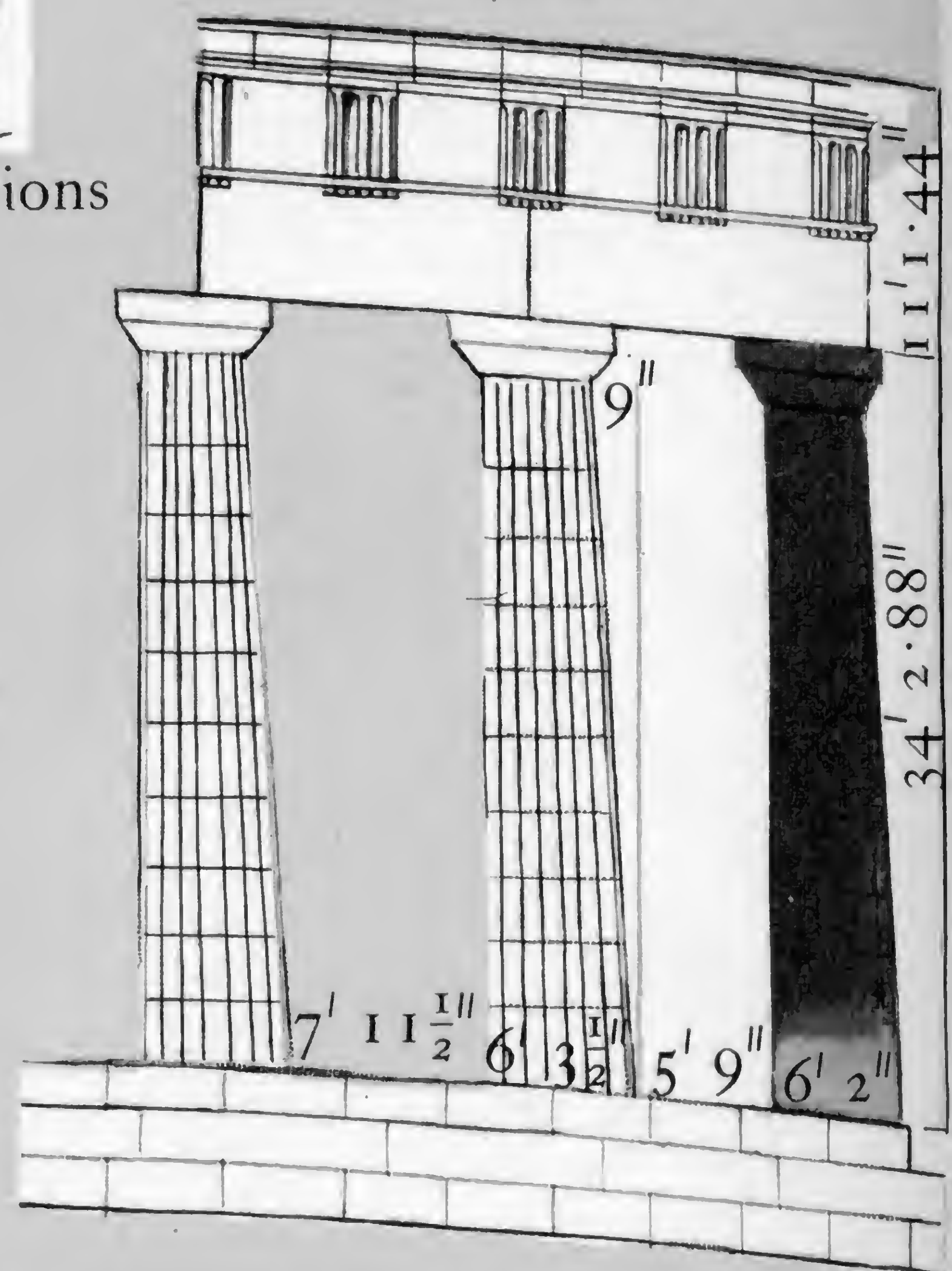


3 The front with inclined axes of columns and with convex stylobate and entablature producing the result seen at 1

Entasis (Gk: distension) designed to counteract the illusion of the outline of a column curving inwards

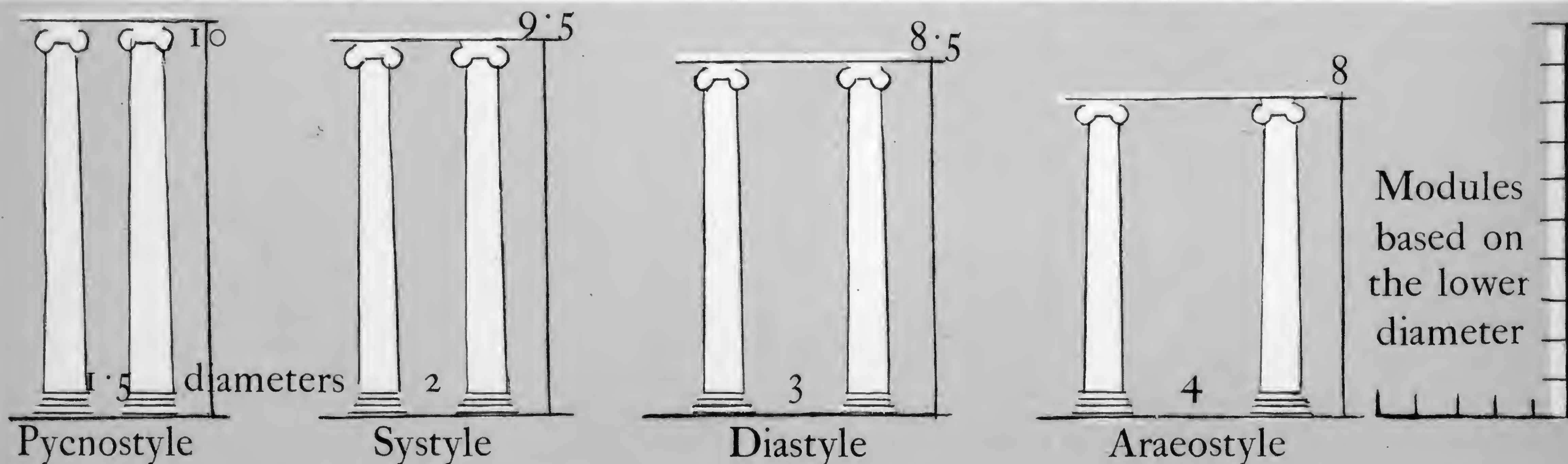


Exaggerated diagram of the rising curvature of the stylobate and inward inclination of the columns



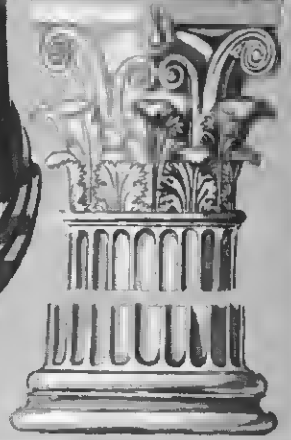
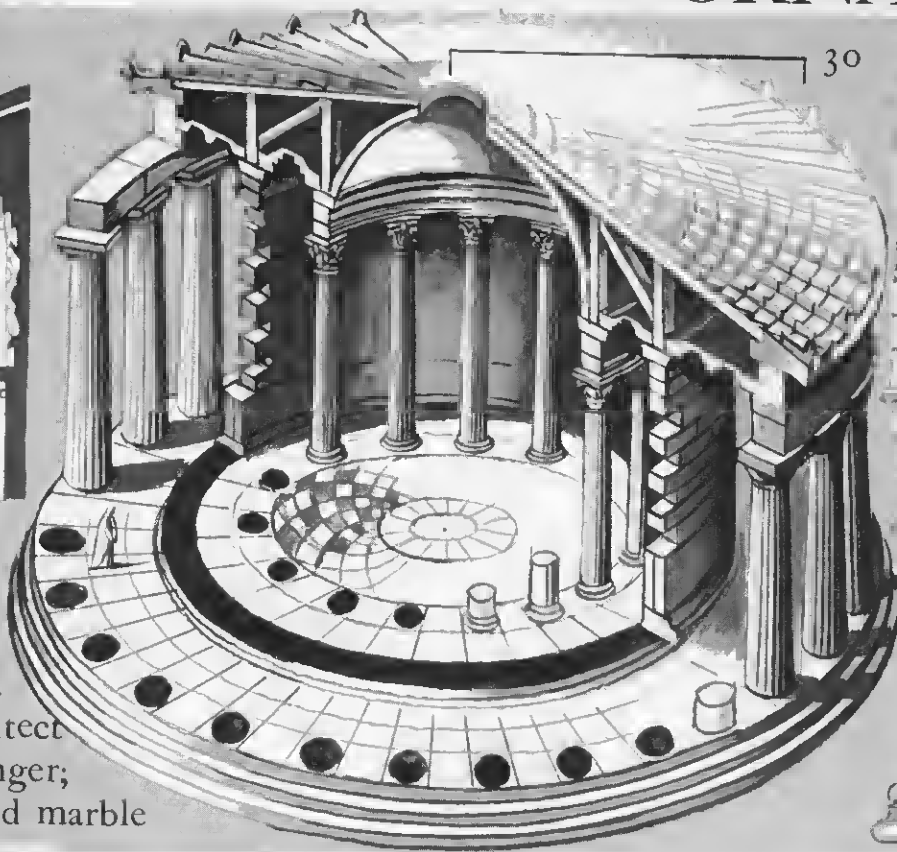
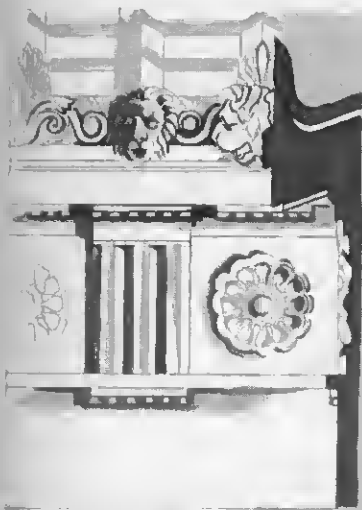
Angle columns look thinner seen dark against light and are thickened by  $1\frac{1}{2}$  in.

## OPTICAL CORRECTIONS, THE PARTHENON, ATHENS



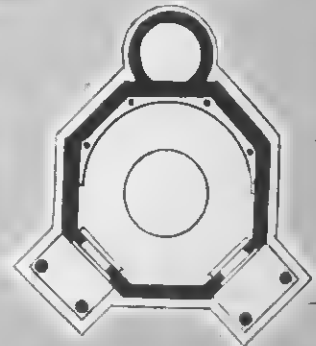
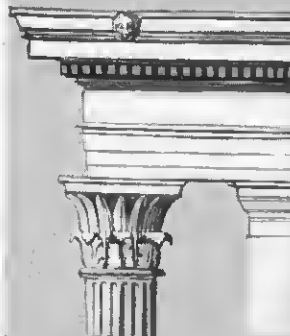
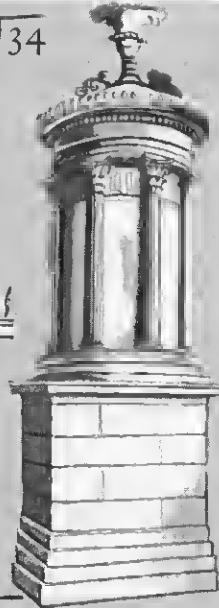
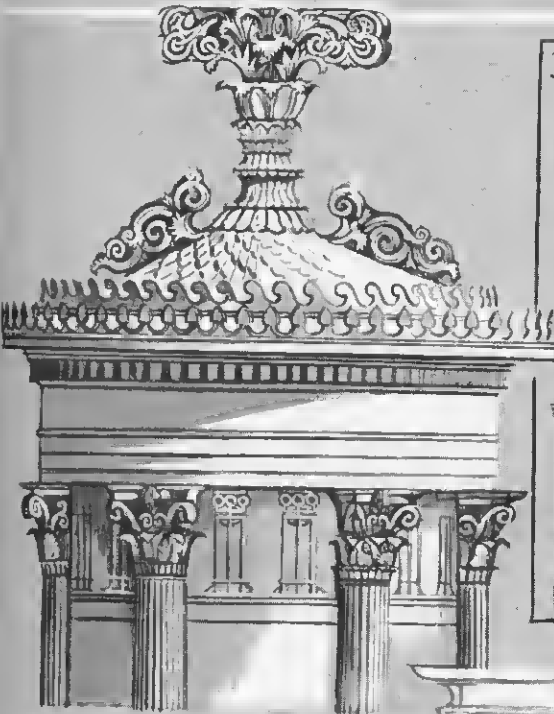
Proportions of height, thickness & distance apart of columns according to Vitruvius (III,3)





The Tholos,

Epidauros, c. 360 B.C.  
by the sculptor-architect  
Polykleitus the Younger;  
built of sandstone and marble



The Choragic

Monument of Lysicrates,  
Athens, c. 334 B.C.  
Podium of limestone,  
upper part white marble,  
Corinthian order used  
externally for the first time

The Tower of the Winds, Athens,  
c. 50 B.C. Clock-tower built of marble



# ROMAN

## THE ROMAN REPUBLIC

c.753 B.C.  
The foundation  
of Rome

Etruscan  
kings

500



200 miles



Carthaginians

Roman territory



500 miles

Italy at the beginning  
of the Roman Republic,  
c.500 B.C.

The Latin conquest  
of Italy,  
275 B.C.

The Roman Empire

Early Rome, with its Republican magistrates, town-council (senatus) and town-meetings (comitia), by a series of systematic conquests created an Empire round the Mediterranean consisting of different nationalities accepted as allies. The Roman Empire became a fusion of the practical Western idea of one universal society in which all men might live in conformity with Roman law and the Oriental conception of an Emperor-God with a throne-altar demanding a common worship and loyalty. This union between the West and the East was a continual source of weakness and led to the ultimate division of the Empire. The Romans built roads and bridges for swift communication, military camps with a simple set plan (later incorporated in many city-plans) for speed of construction, and government and civic buildings, which were both useful and symbolic of Roman law and order.

Greek Hellenic Period

Hellenistic

775/6

429/8 — Plato — 347  
384 Aristotle 322

342-Epicurus-270

326? — Zeno — 264? (Stoicism)



# INTRODUCTION

## THE ROMAN EMPIRE

29 A.D.					284	324	394	476 A.D.
Julius Caesar	Augustus	Nero	Trajan	Septimus Severus	The capital, Rome, moved to Byzantium by Constantine			End of the Western Empire
106—44	27—14	59—68	98—117	192—211	306—337			
		Vespasian	Hadrian					
		69—79	117—138					



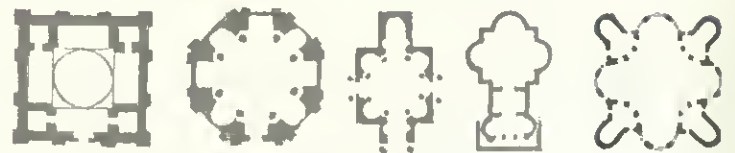
27 B.C. — A.D. 324



The Division of the Empire

394 A.D.

During the Republic kiln-baked bricks and stone blocks with or without mortar were used in building. The invention of concrete revolutionised construction in the Empire. Concrete was used with a facing for protection and a surface finish, & there is a sharp distinction between the art of the engineer constructing arches, vaults and domes and the applied art of decoration with columns and pilasters, marbles and mosaics.

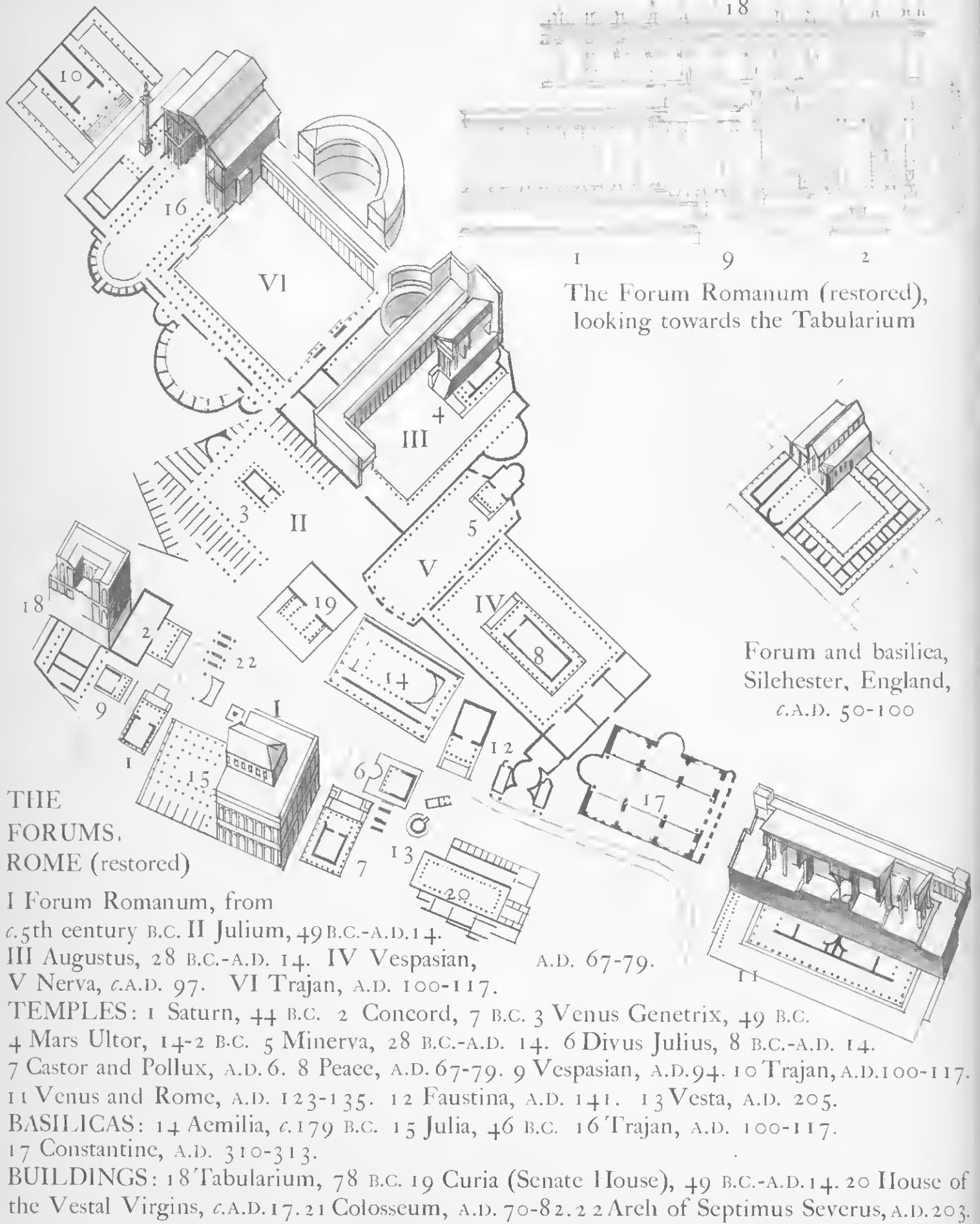


The Romans invented all possible variations in the plans of buildings which were copied by later architects. *The Ten Books on Architecture* by Marcus Vitruvius Pollio, a Roman architect and engineer who lived in the 1st century B.C. was widely read in the Renaissance and later.

A.D.						
31					323	
106—43	Cicero				Christianity	
70—	Virgil				the official religion	
65—	Horace				of the Empire.	
59—	Livy					
46?	Plutarch	120?	203—	Plotinus—262	354	St Augustine 430



# ROMAN



## THE FORUMS. ROME (restored)

I Forum Romanum, from  
c.5th century B.C. II Julium, 49 B.C.-A.D.14.  
III Augustus, 28 B.C.-A.D. 14. IV Vespasian, A.D. 67-79.  
V Nerva, c.A.D. 97. VI Trajan, A.D. 100-117.

TEMPLES: 1 Saturn, 44 B.C. 2 Concord, 7 B.C. 3 Venus Genetrix, 49 B.C.  
4 Mars Ultor, 14-2 B.C. 5 Minerva, 28 B.C.-A.D. 14. 6 Divus Julius, 8 B.C.-A.D. 14.  
7 Castor and Pollux, A.D. 6. 8 Peace, A.D. 67-79. 9 Vespasian, A.D. 94. 10 Trajan, A.D. 100-117.  
11 Venus and Rome, A.D. 123-135. 12 Faustina, A.D. 141. 13 Vesta, A.D. 205.  
BASILICAS: 14 Aemilia, c.179 B.C. 15 Julia, 46 B.C. 16 Trajan, A.D. 100-117.  
17 Constantine, A.D. 310-313.  
BUILDINGS: 18 Tabularium, 78 B.C. 19 Curia (Senate House), 49 B.C.-A.D.14. 20 House of  
the Vestal Virgins, c.A.D.17. 21 Colosseum, A.D. 70-82. 22 Arch of Septimus Severus, A.D.203.



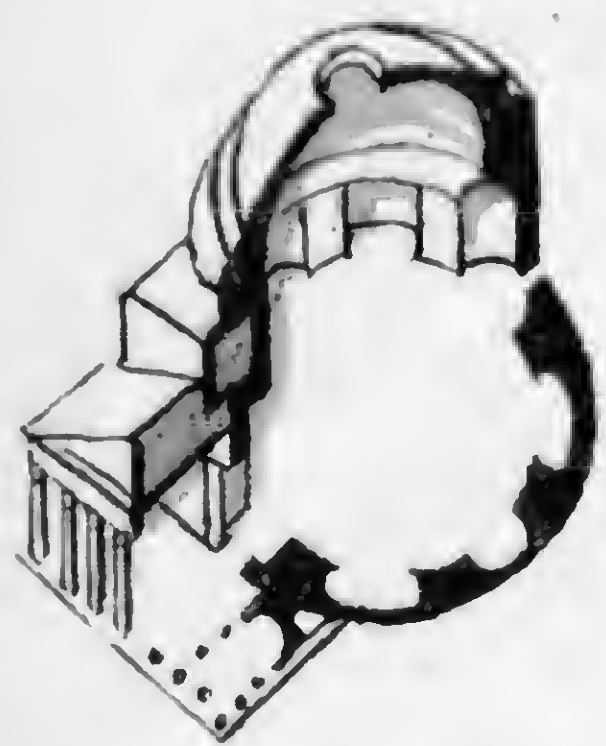
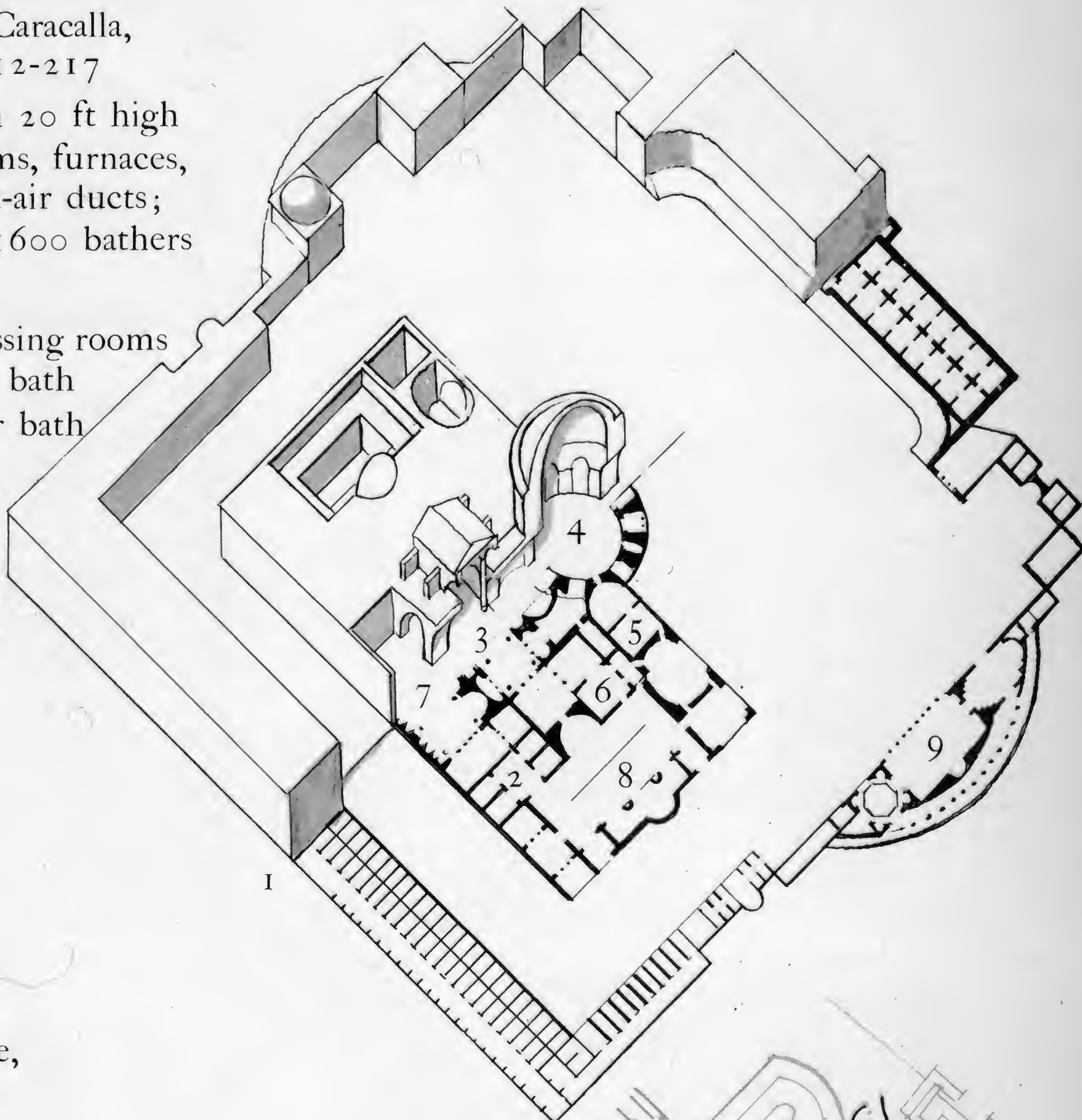
# BUILDINGS AND PLANS, ROME

Drawn to the same scale  500

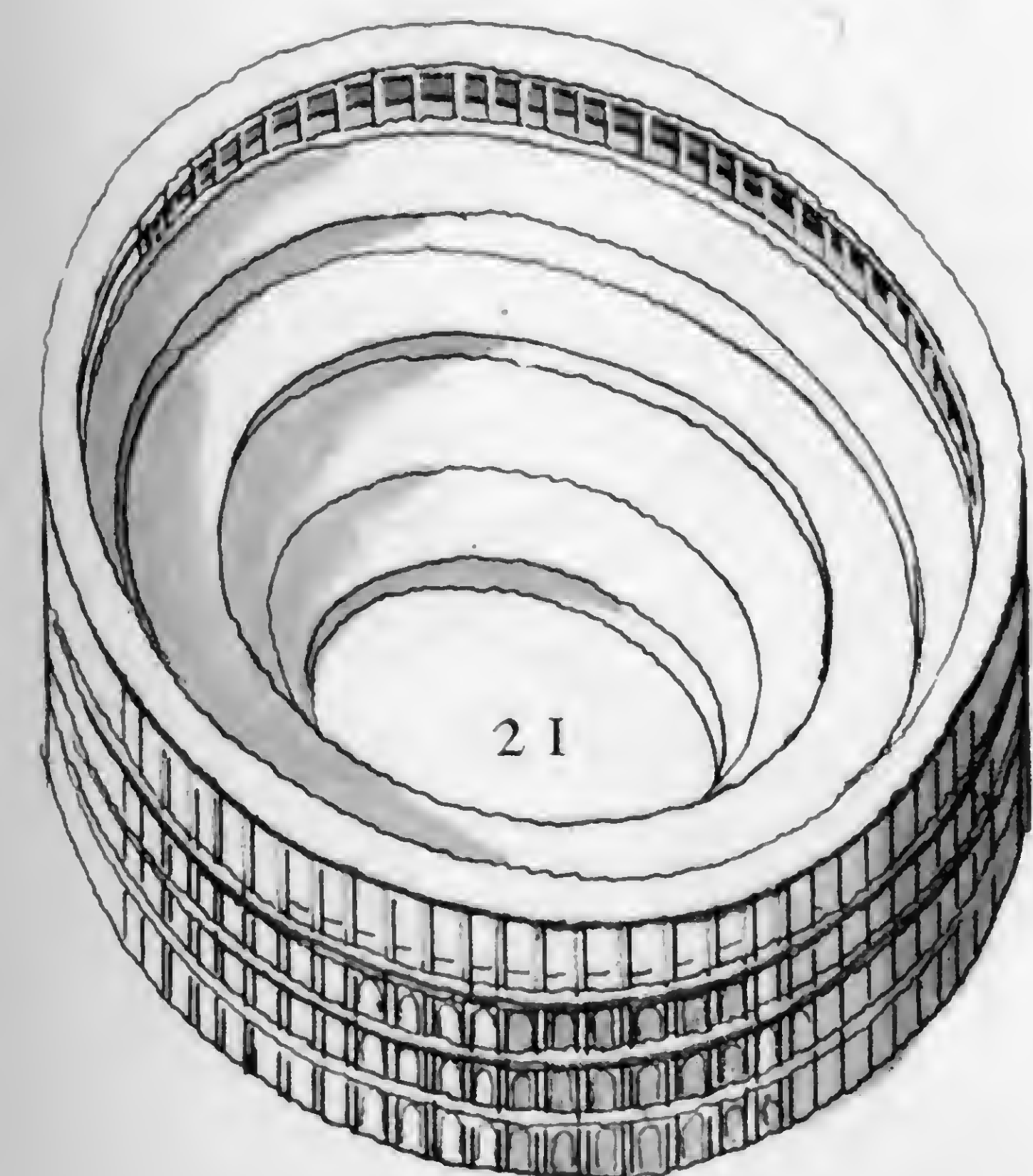
## The Thermae of Caracalla, Rome, c. A.D. 212-217

Stands on a platform 20 ft high containing store-rooms, furnaces, hypocausts and hot-air ducts; room for more than 1600 bathers

- 1 Main entrance
- 2 Apodyteria—undressing rooms
- 3 Tepidarium—tepid bath
- 4 Calidarium—hot-air bath
- 5 Warm baths
- 6 Hot baths
- 7 Frigidarium—open-air cold bath
- 8 Palaestra, peristyles
- 9 Lecture halls and libraries

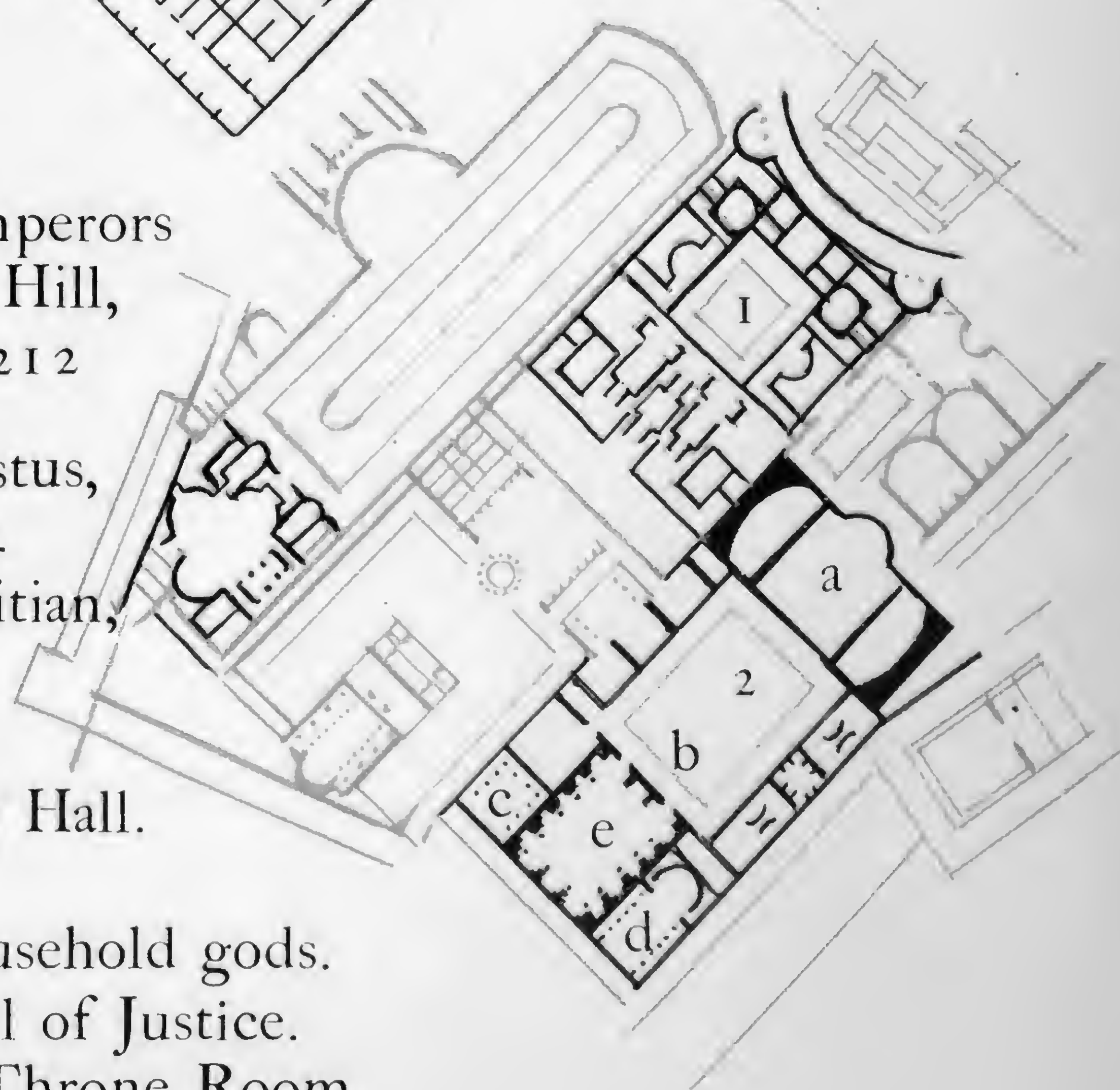


## The Pantheon, Rome, A.D. 120-124



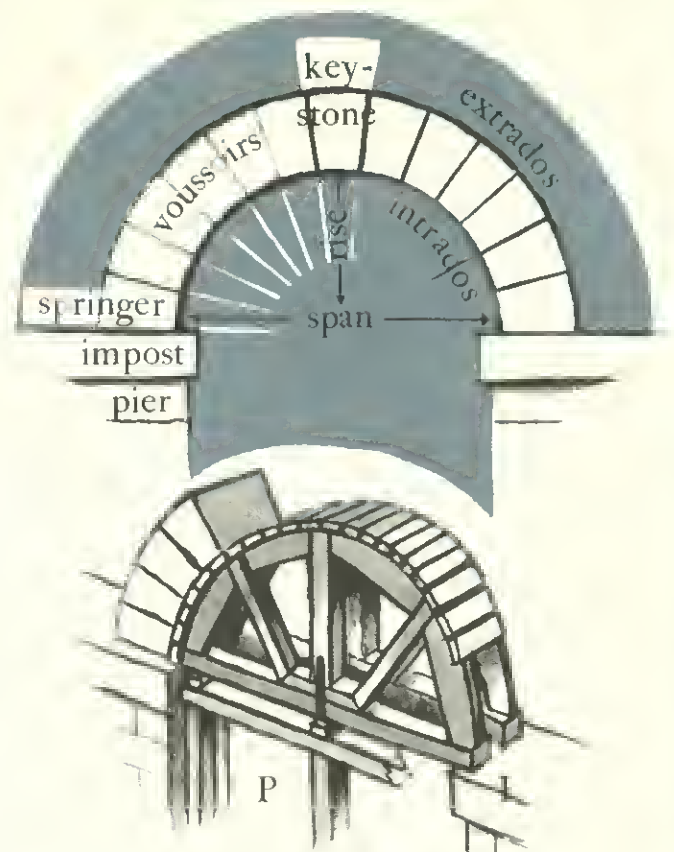
## Palaces of the Emperors on the Palatine Hill, Rome, A.D. 3-212

- 1 Palace of Augustus, 21 B.C.-A.D. 14
- 2 Palace of Domitian, A.D. 81-96
- a. Triclinium or Banqueting Hall.
- b. Peristyle.
- c. Temple of household gods.
- d. Basilica or Hall of Justice.
- e. Tablinum or Throne Room

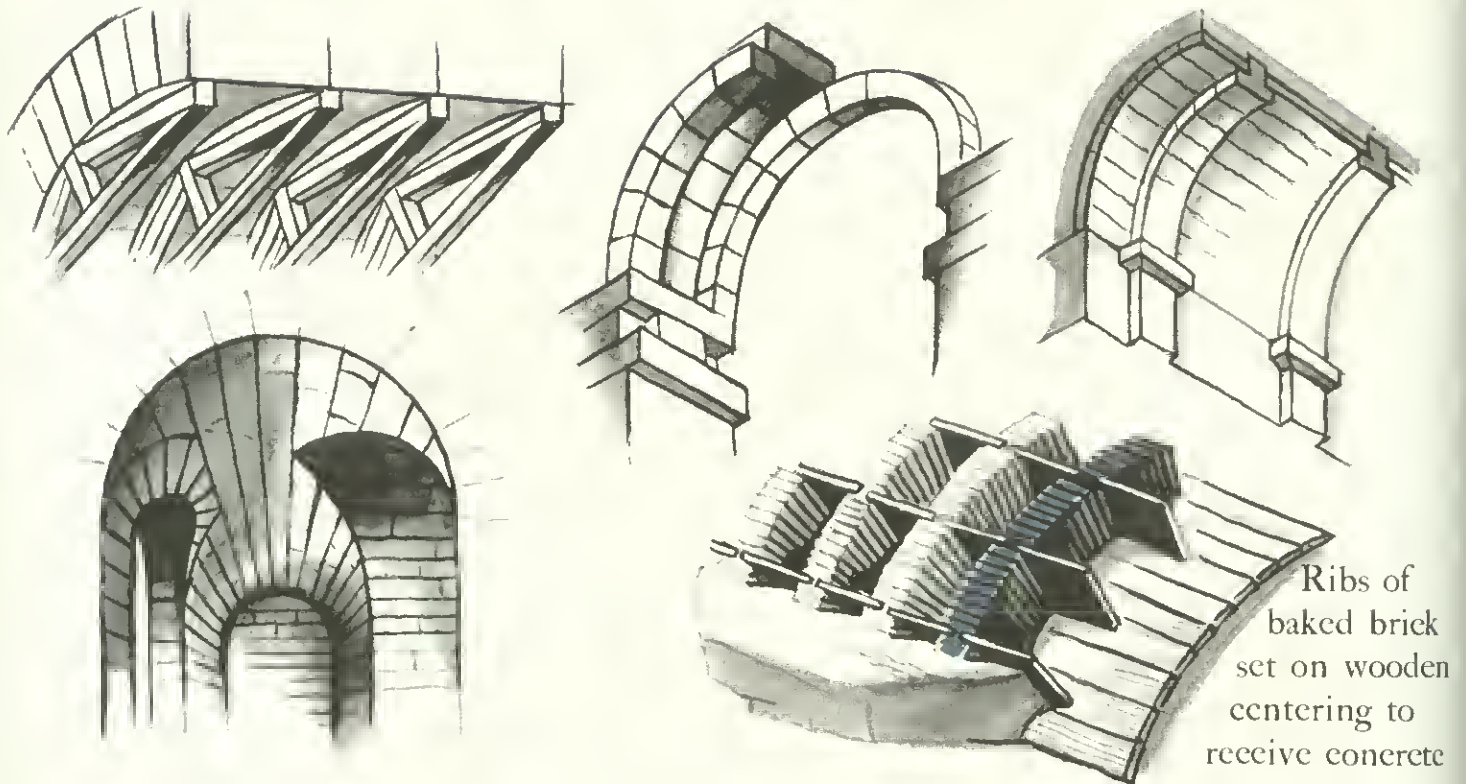




# ROMAN



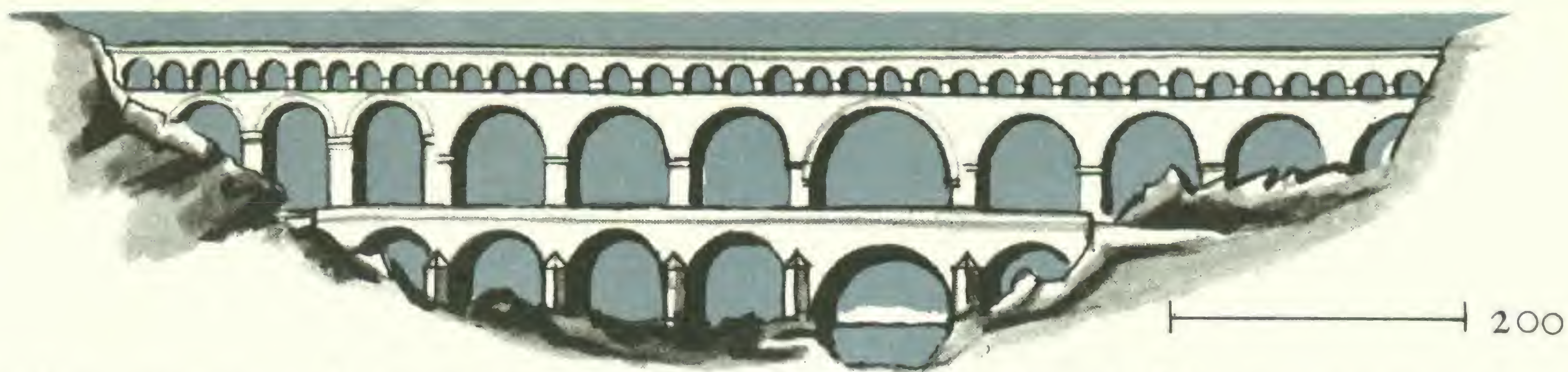
Wooden centering supported on piles P or on the impost I



Methods of constructing stone and concrete vaults



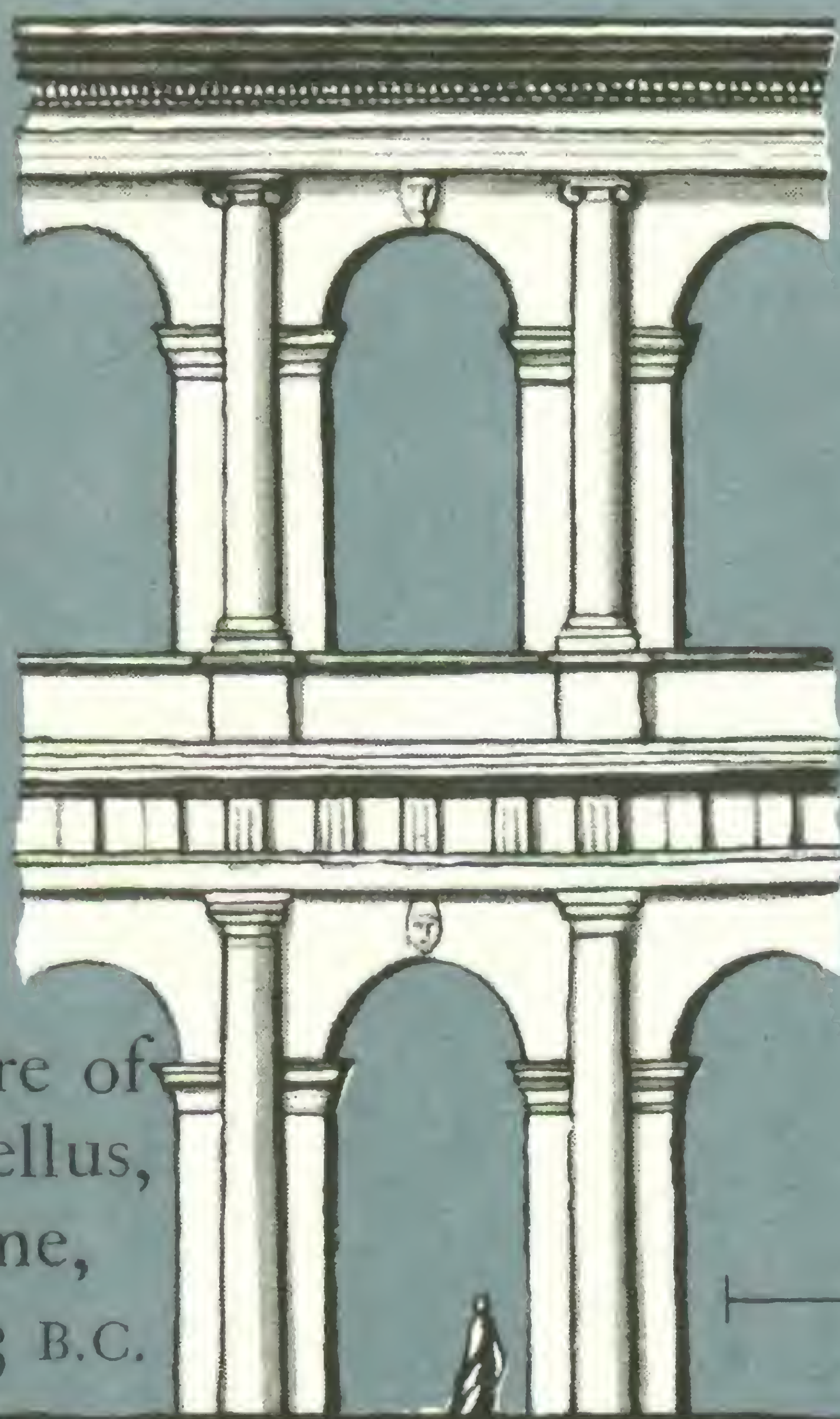
# THE ARCH



Arches supported on piers: Aqueduct, Pont du Gard, Nîmes, c.A.D. 150



Theatre of  
Marcellus,  
Rome,  
23-13 B.C.

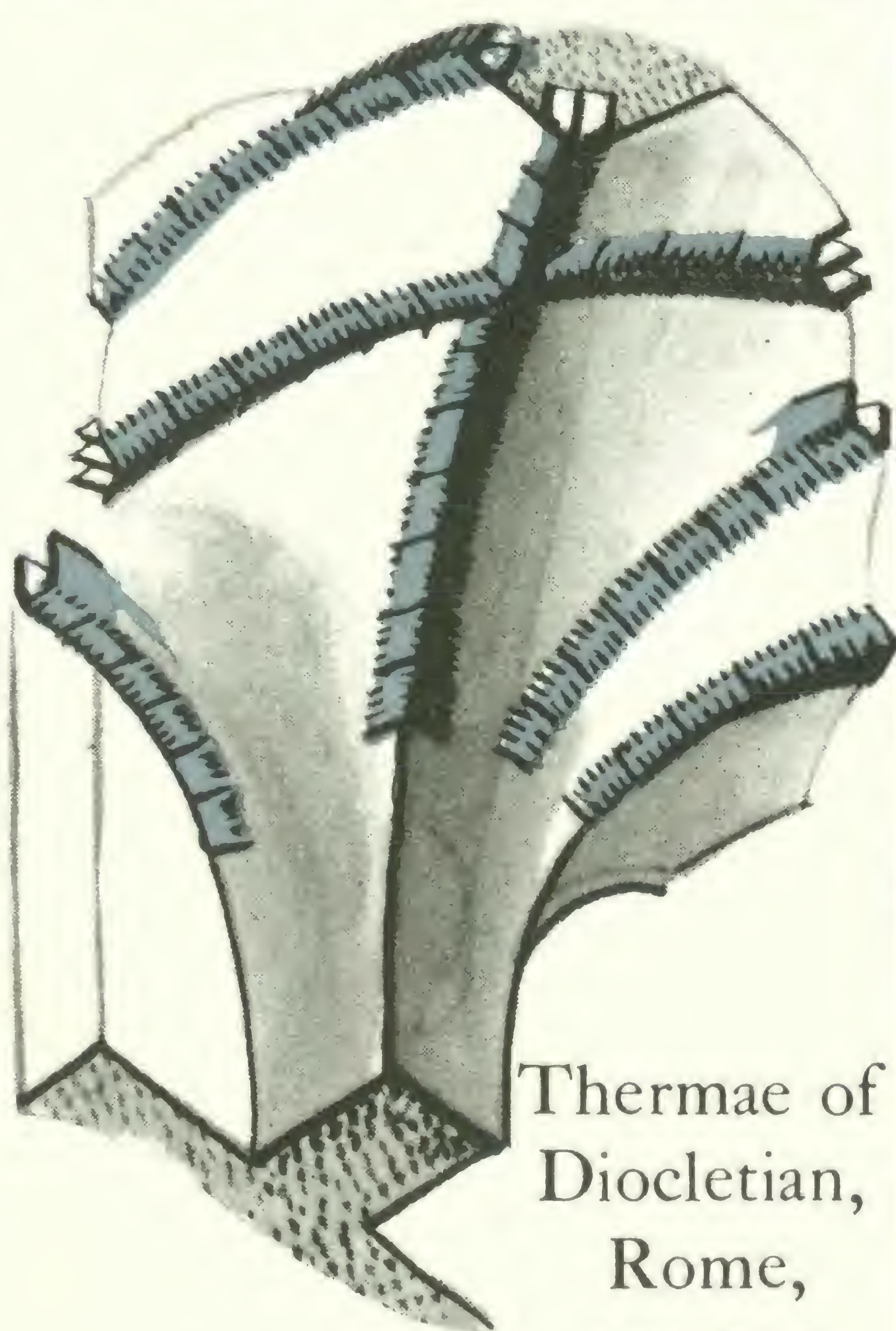


Theatre,  
Arles,  
1st-3rd  
cent. A.D.

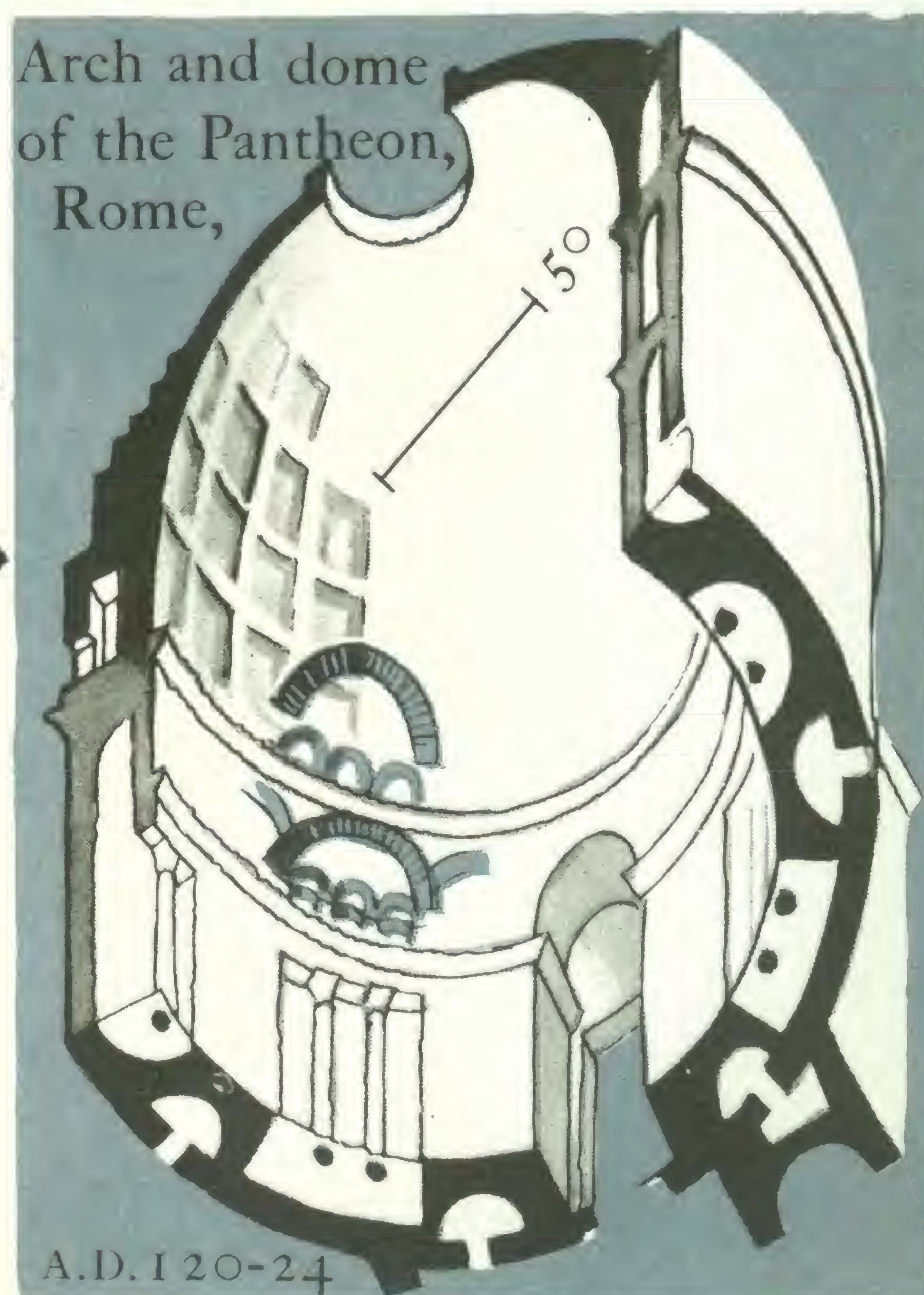
Construction of arches on piers with non-constructural facing of columns and entablature



The Basilica  
of Constantine,  
Rome, A.D. 310-13



Thermae of  
Diocletian,  
Rome,  
A.D. 302



Arch and dome  
of the Pantheon,  
Rome,  
A.D. 120-24

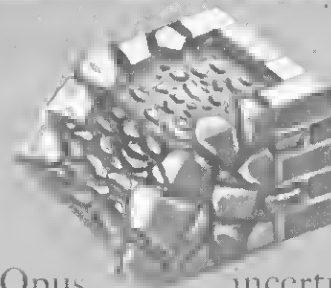
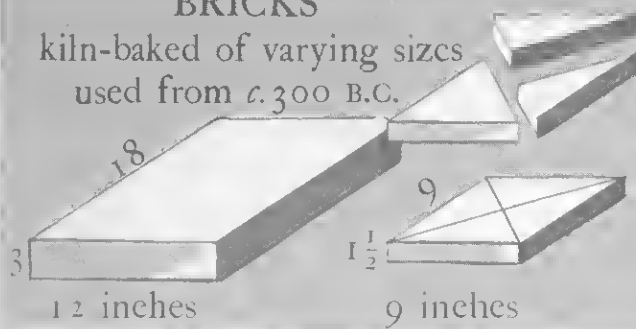
Brick ribs in concrete cross-vaults



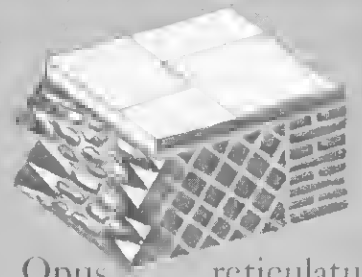
# ROMAN

## BRICKS

kiln-baked of varying sizes  
used from c. 300 B.C.



Opus incertum  
from c. 200 B.C.

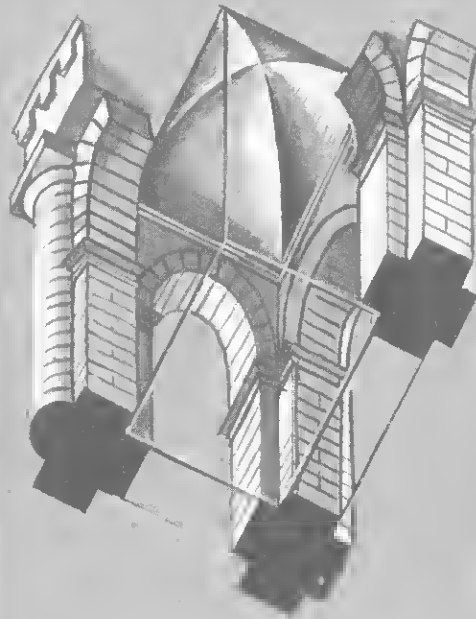


Opus reticulatum  
Concrete walls faced

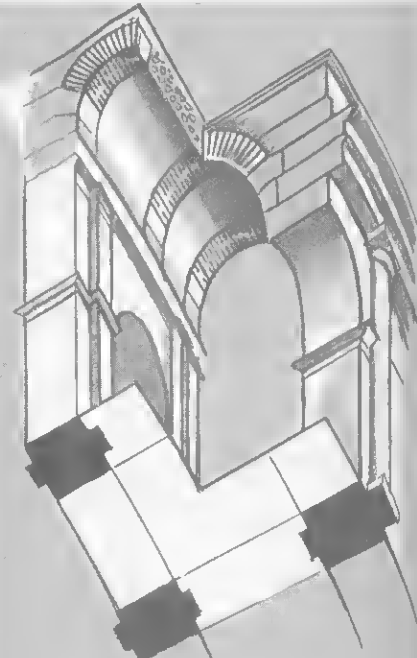
## CONCRETE

used by the Romans from the 2nd century B.C., consisting of sand, gravel, pebbles, chippings of stone, mixed with a cement of lime and water and spread over a temporary wooden or permanent brick centering, to solidify into the required shape—arch, vault or dome. The dead weight rested upon supporting walls or piers without exerting an outward thrust. Pozzolana, a volcanic rock found near Rome, made a concrete of great hardness and durability.

Concrete surfaces were faced with stucco, brick or marble for protection and finish.

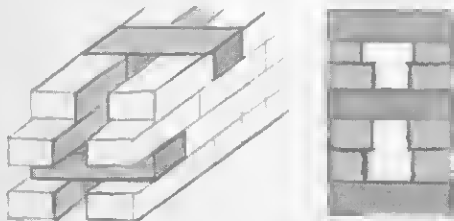


Cloister vault of concrete  
supported on cruciform piers  
Tabularium, Rome, 78 B.C.

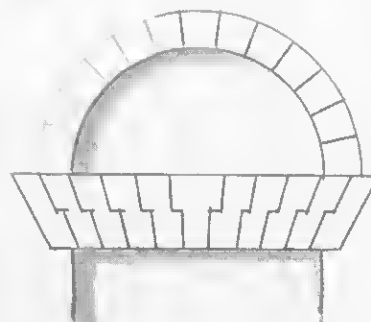
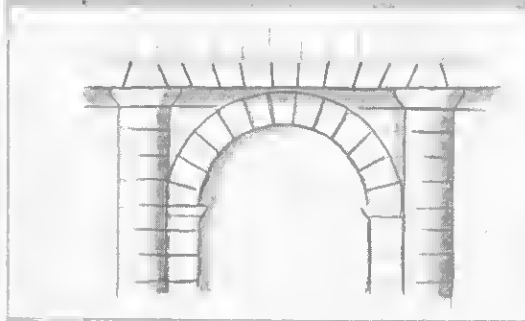


Concrete barrel vault  
The Colosseum, Rome,  
A.D. 70-82

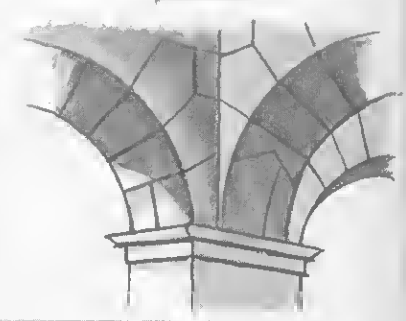
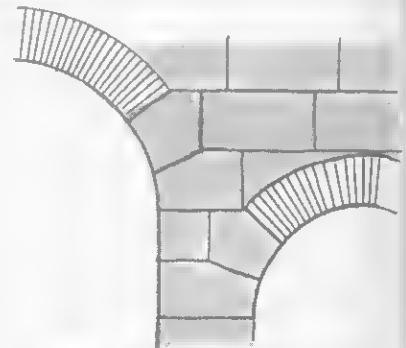
## MASONRY



The Romans copied the Greek technique, building courses of dressed blocks, held by through stones laid dry without mortar or with iron cramps and dowels set in molten lead. The space between the courses was left empty or filled with undressed stones, earth or concrete.

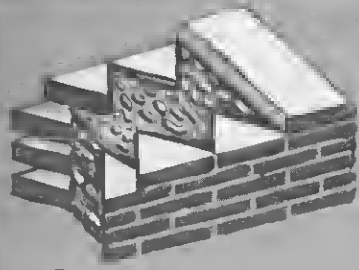


Flat arch: Orange

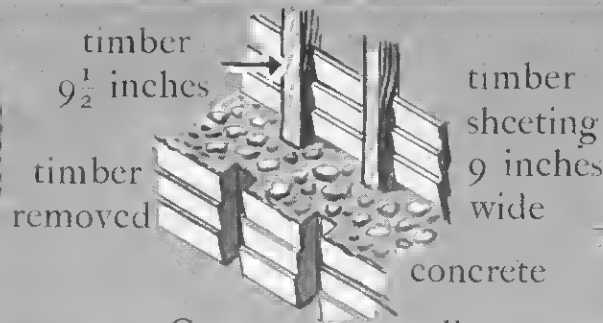




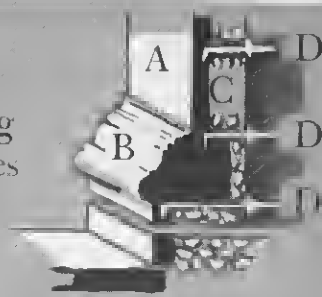
# MATERIALS & METHODS



Opus testaceum  
with brick from c.78 B.C.

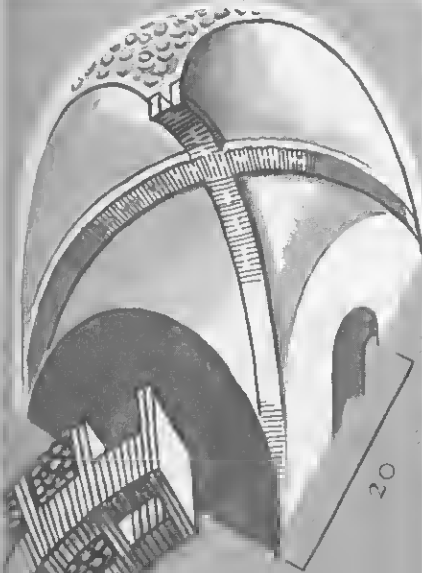


Cast concrete wall

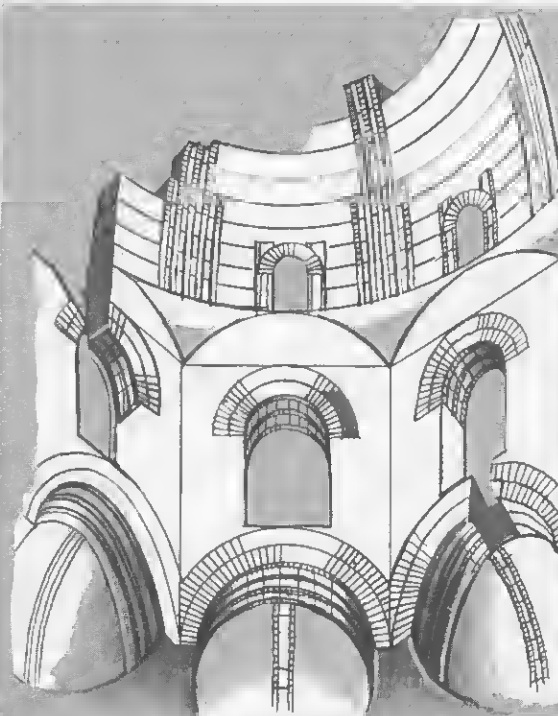


Method of fixing marble facing

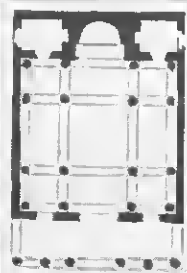
A marble slab  
B plinth  
C cement  
D iron clamps



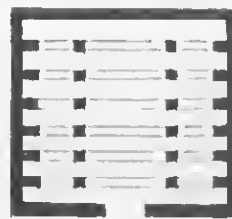
Cross-vault  
built of brick ribs  
and filled in with concrete  
Villa Sette Bassi, near  
Rome, c.A.D. 123-134



Concrete dome with a framework of  
brick ribs  
Temple of Minerva Medica, Rome, c.A.D. 260



The  
Pretorium,  
Musmiych,  
c.A.D. 180



— 65 —

The Basilica,  
Shakka,  
c.A.D. 175-200

Syria:

buildings of dressed stone  
continued in the period of  
Early Christian architecture in  
the 5th to 7th centuries

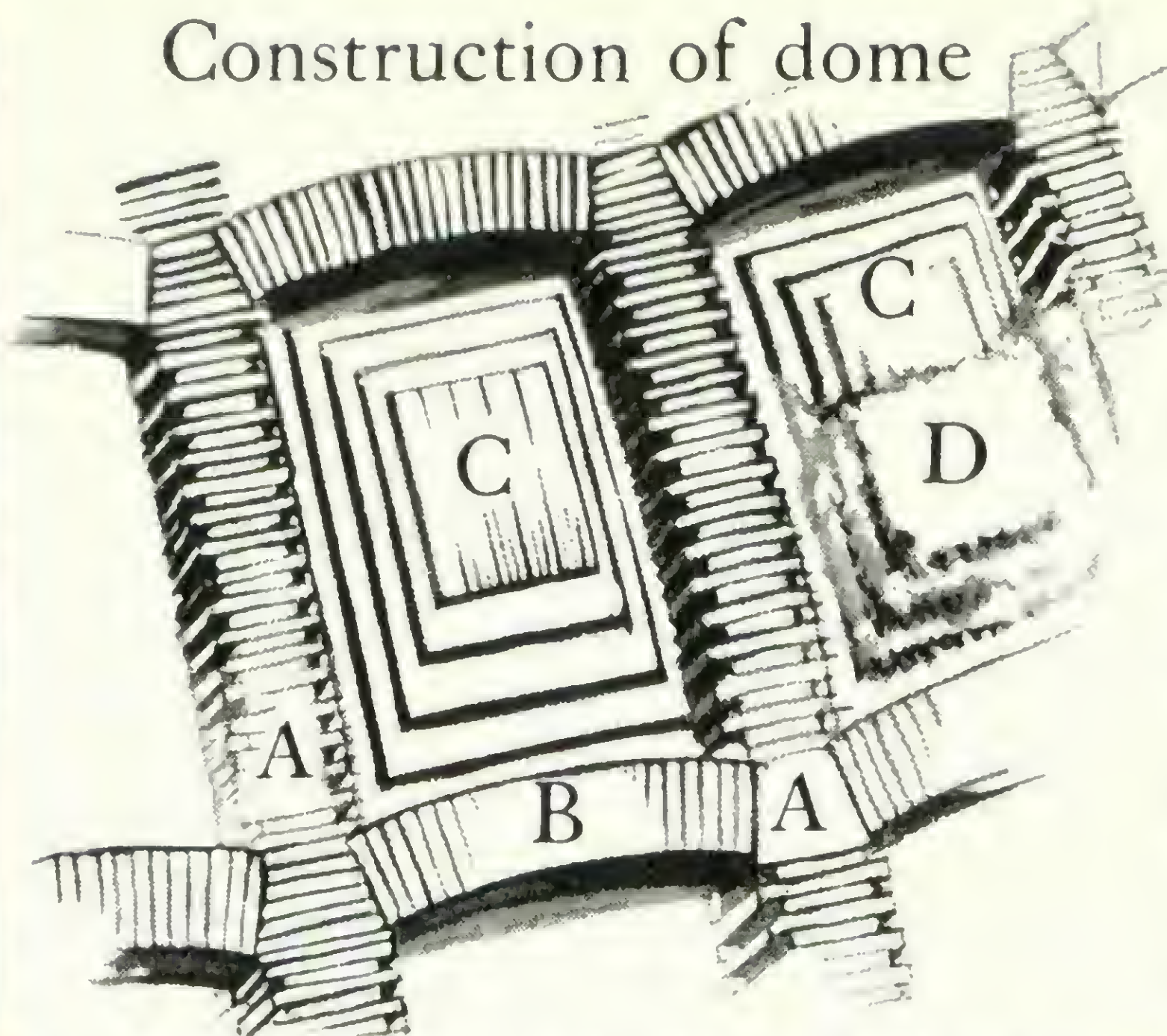




# ROMAN



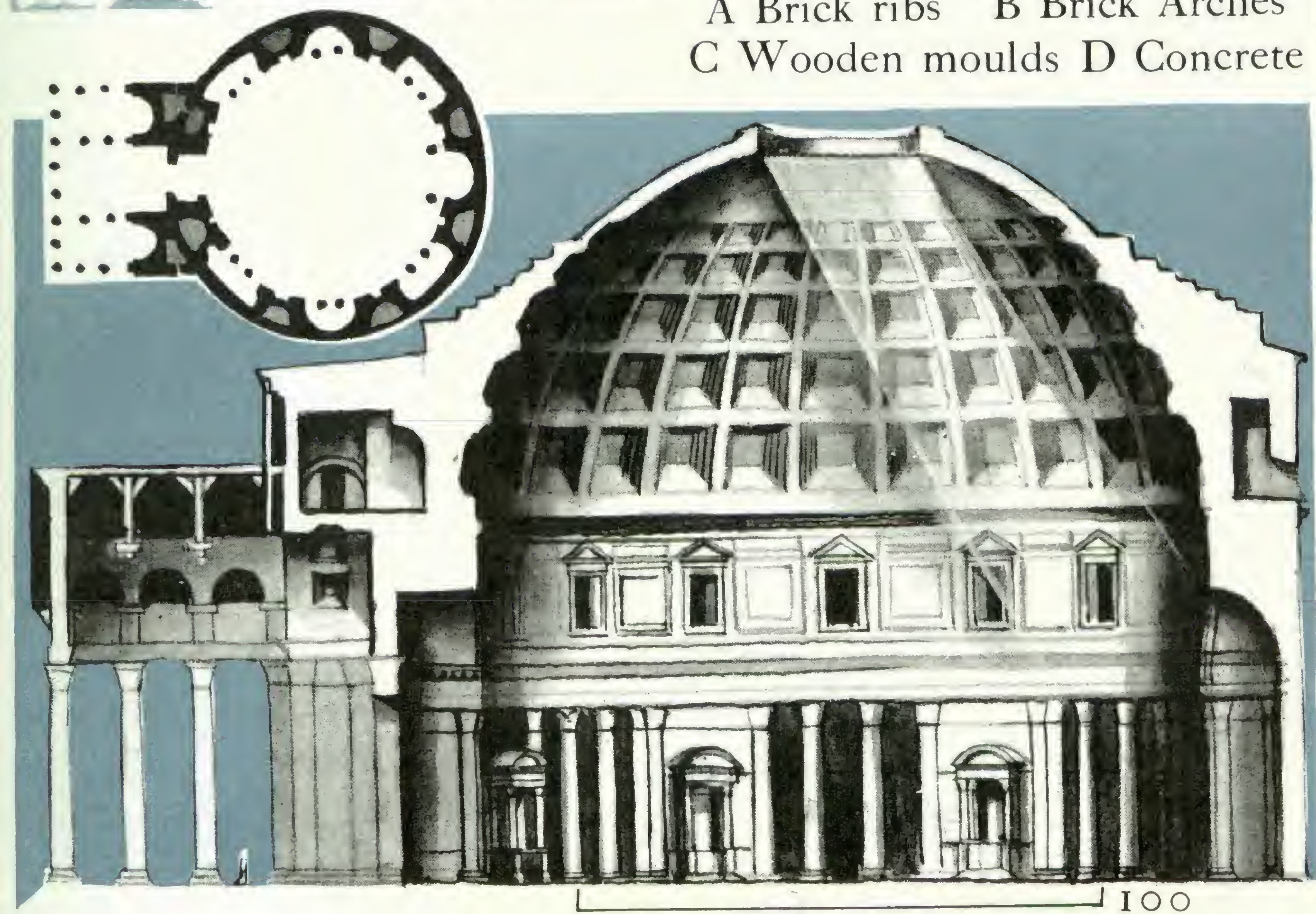
Construction of dome



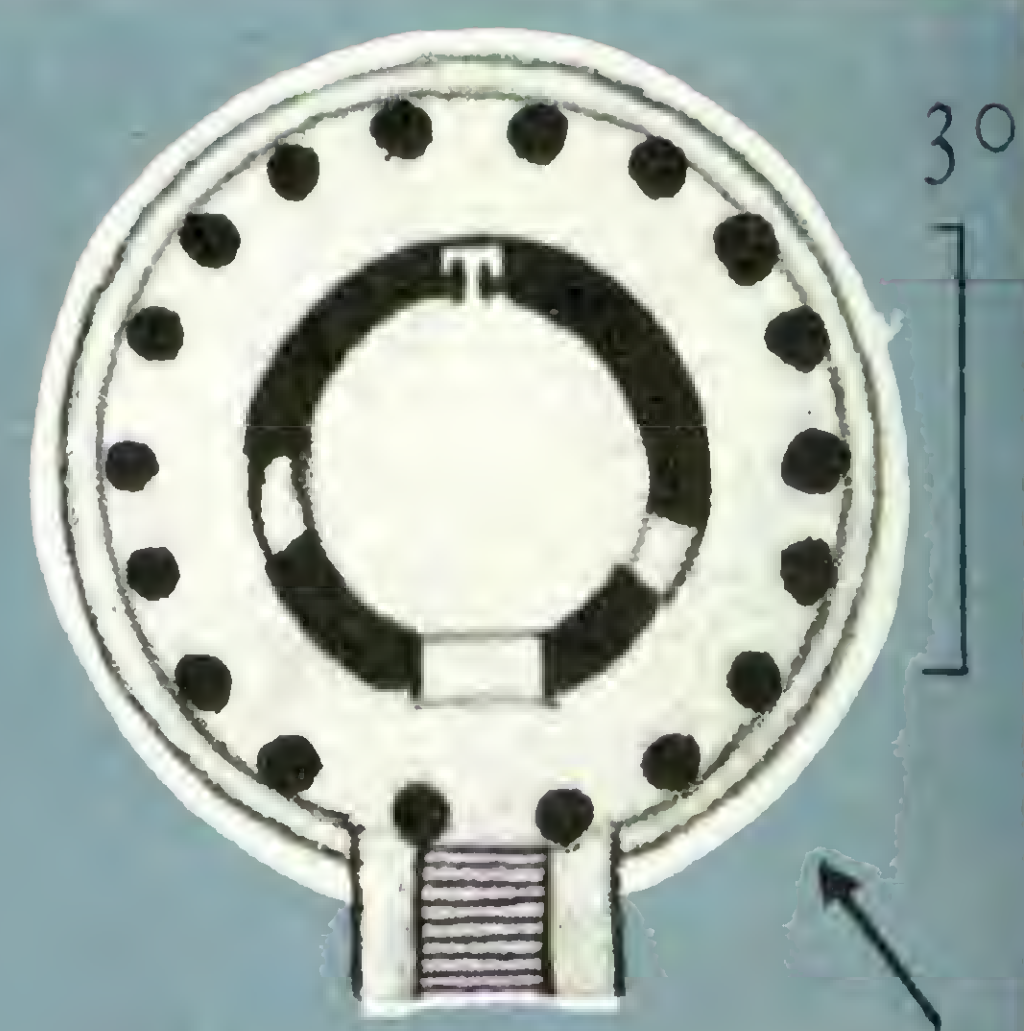
A Brick ribs B Brick Arches  
C Wooden moulds D Concrete



Concealed brick arches link together 8 massive brick piers supporting the dome



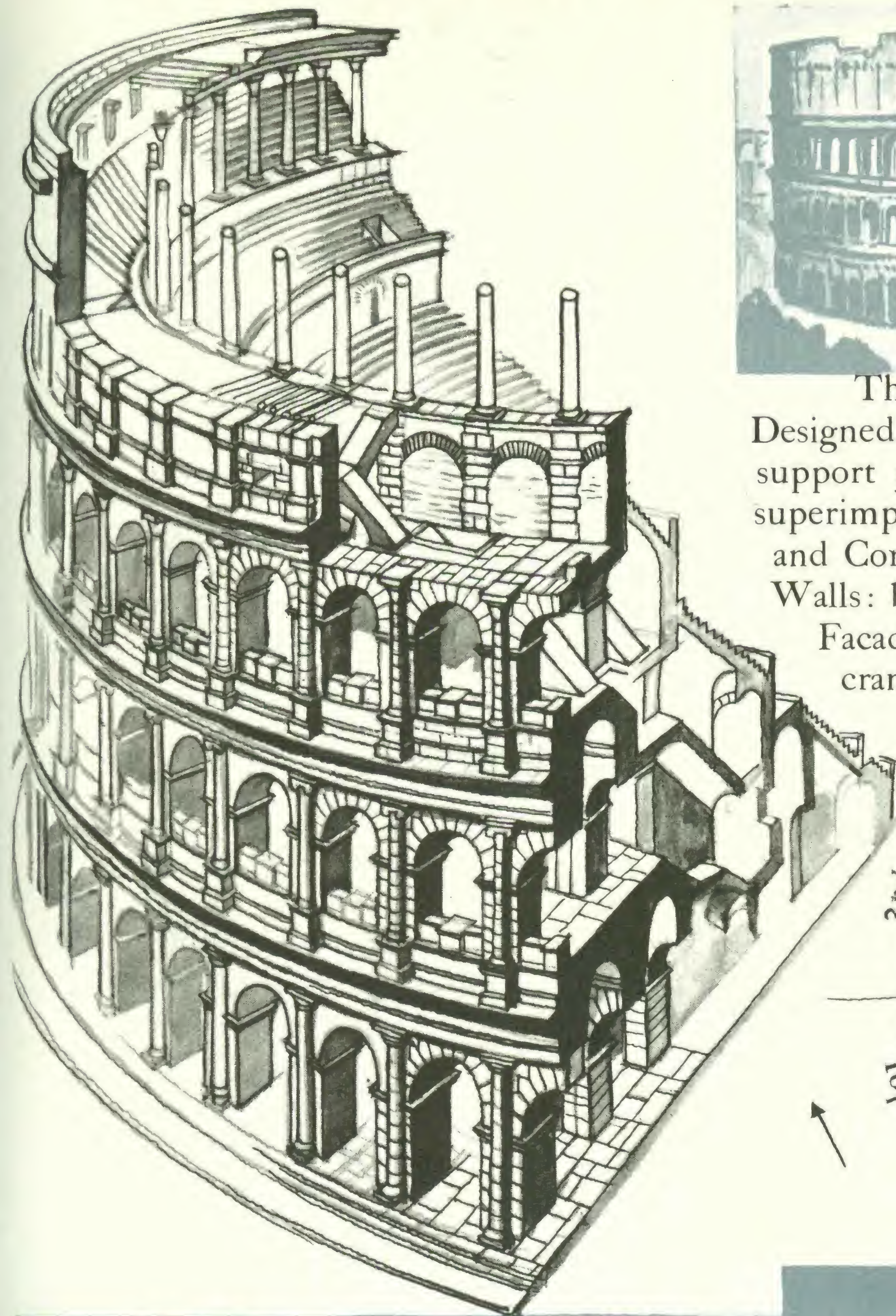
The Pantheon, Rome, A.D. 120-24. Erected by Hadrian



The Temple of Vesta, Tivoli (restored), 27 B.C.-A.D. 14  
Foundations: tufa. Podium and walls: concrete.  
Columns and door: travertine. Roof: probably a low concrete dome

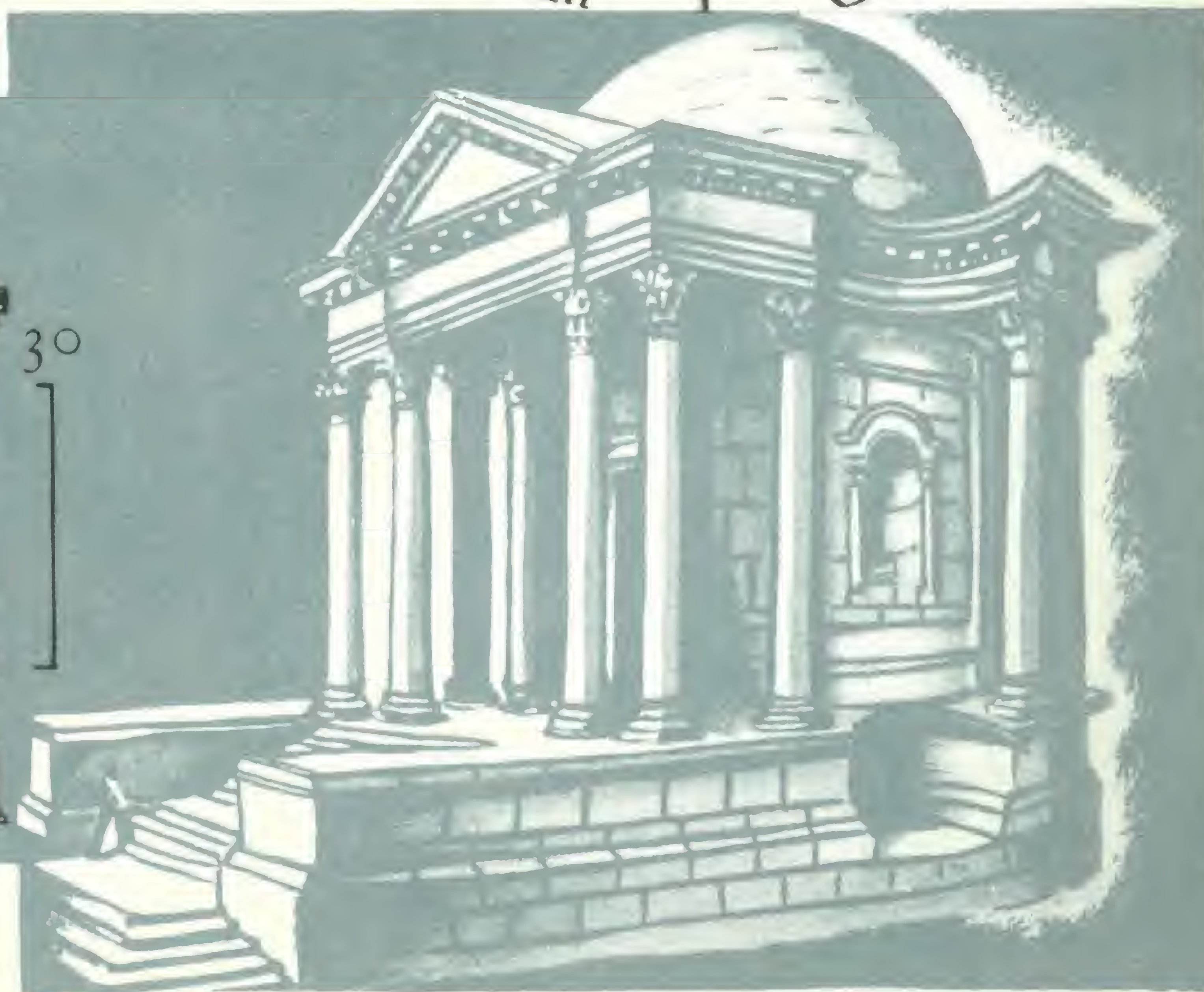
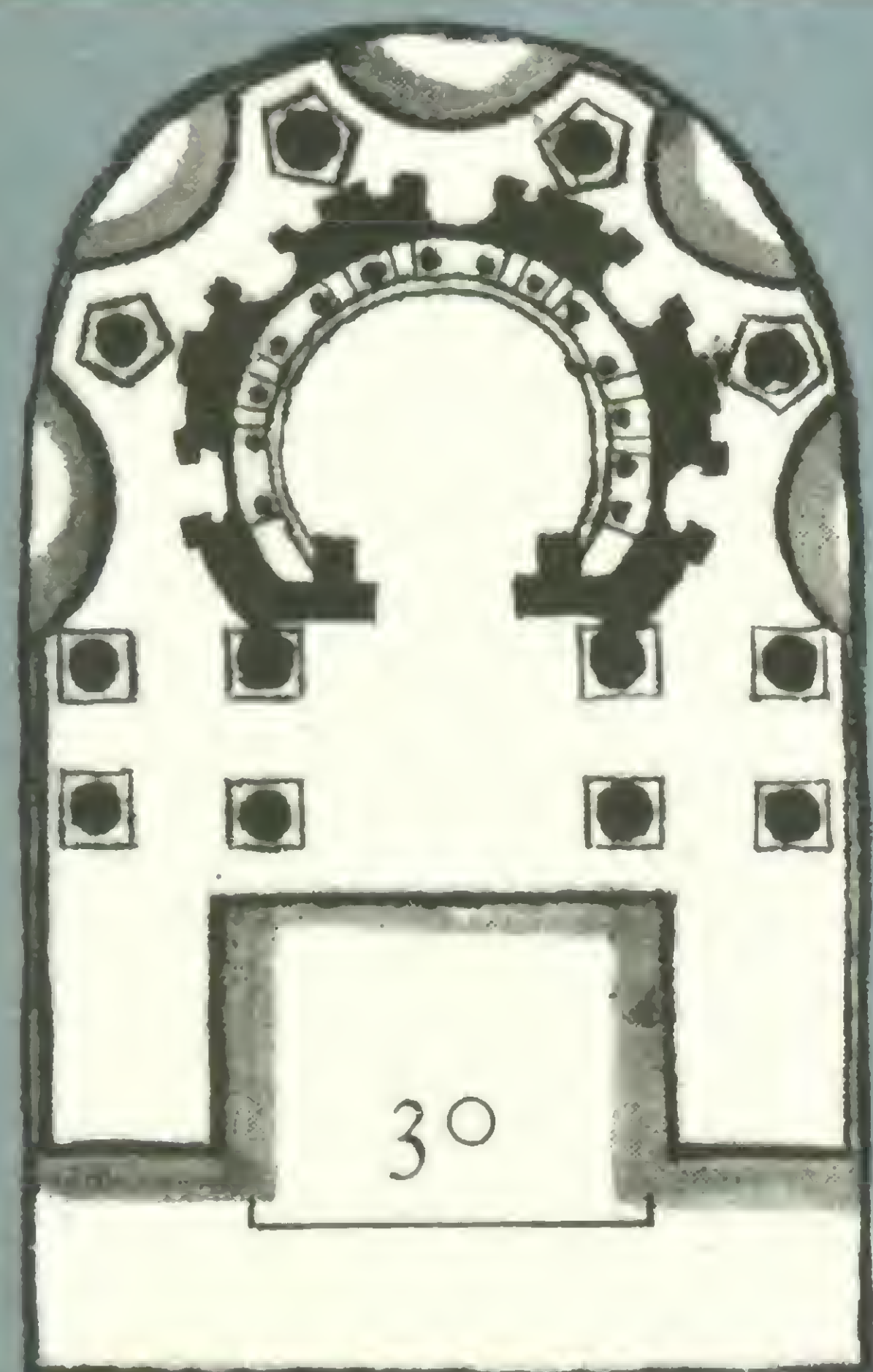
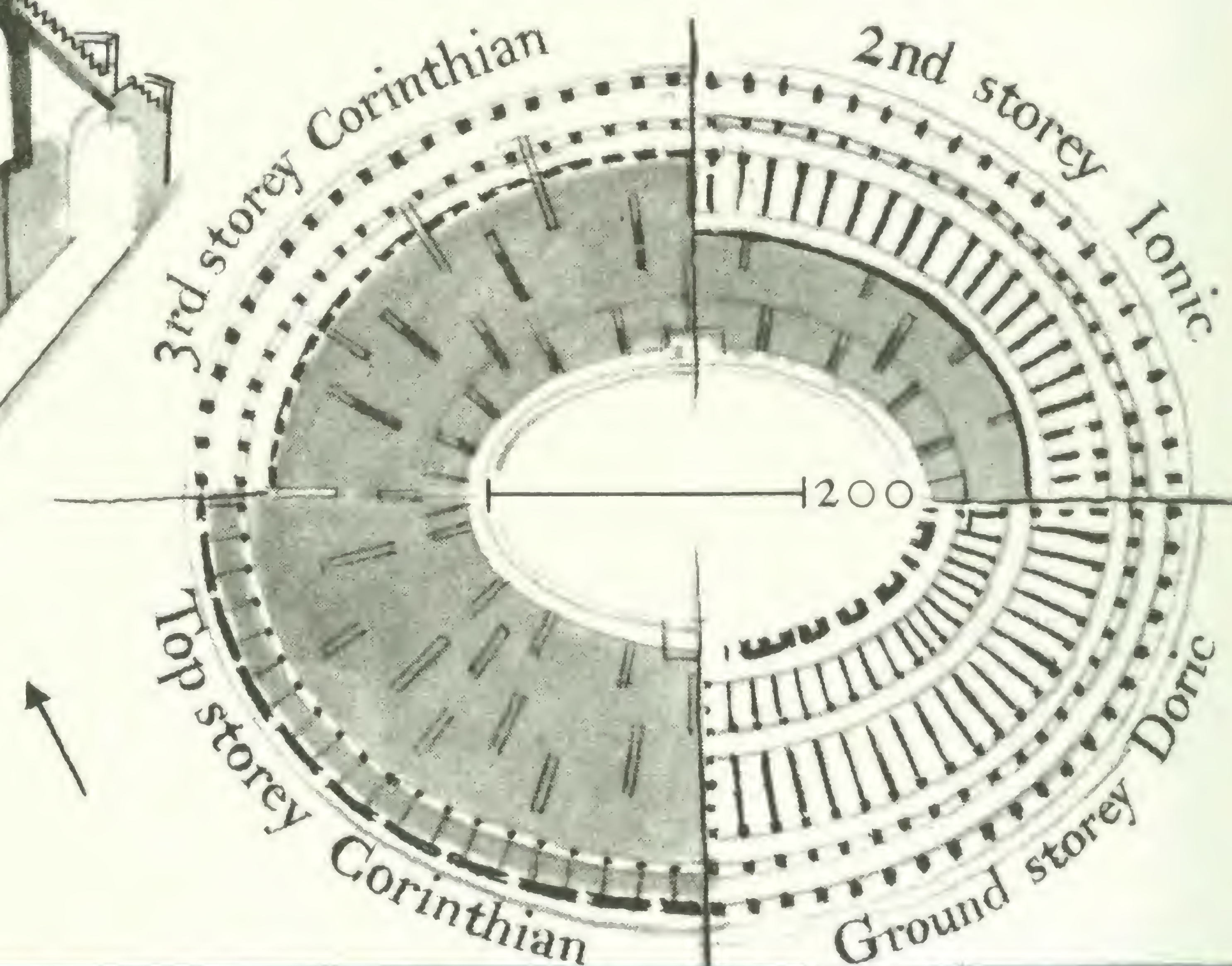


# CIRCULAR & OVAL BUILDINGS



The Colosseum, Rome, A.D. 70-82

Designed for about 45,000 spectators. 80 piers support 3 tiers of arcading. Decorative use of superimposed orders of  $\frac{3}{4}$  external Doric, Ionic and Corinthian columns. Foundations: lava. Walls: brick and tufa. Vaults: pumice-stone. Facade: travertine blocks held by metal cramps. Columns and seats: marble



The Temple of Venus, Baalbek (restored),  
c.A.D. 245



# TEMPLES

Temple of Bacchus,  
c. A.D. 120-200

Temple of Jupiter,  
from c. A.D. 10

Court, c. A.D. 200

340

Temple of Bacchus: interior

TEMPLES, BAALBEK, SYRIA  
(restored), c. 1st-2nd  
centuries A.D.;  
built of hard  
local sandstone

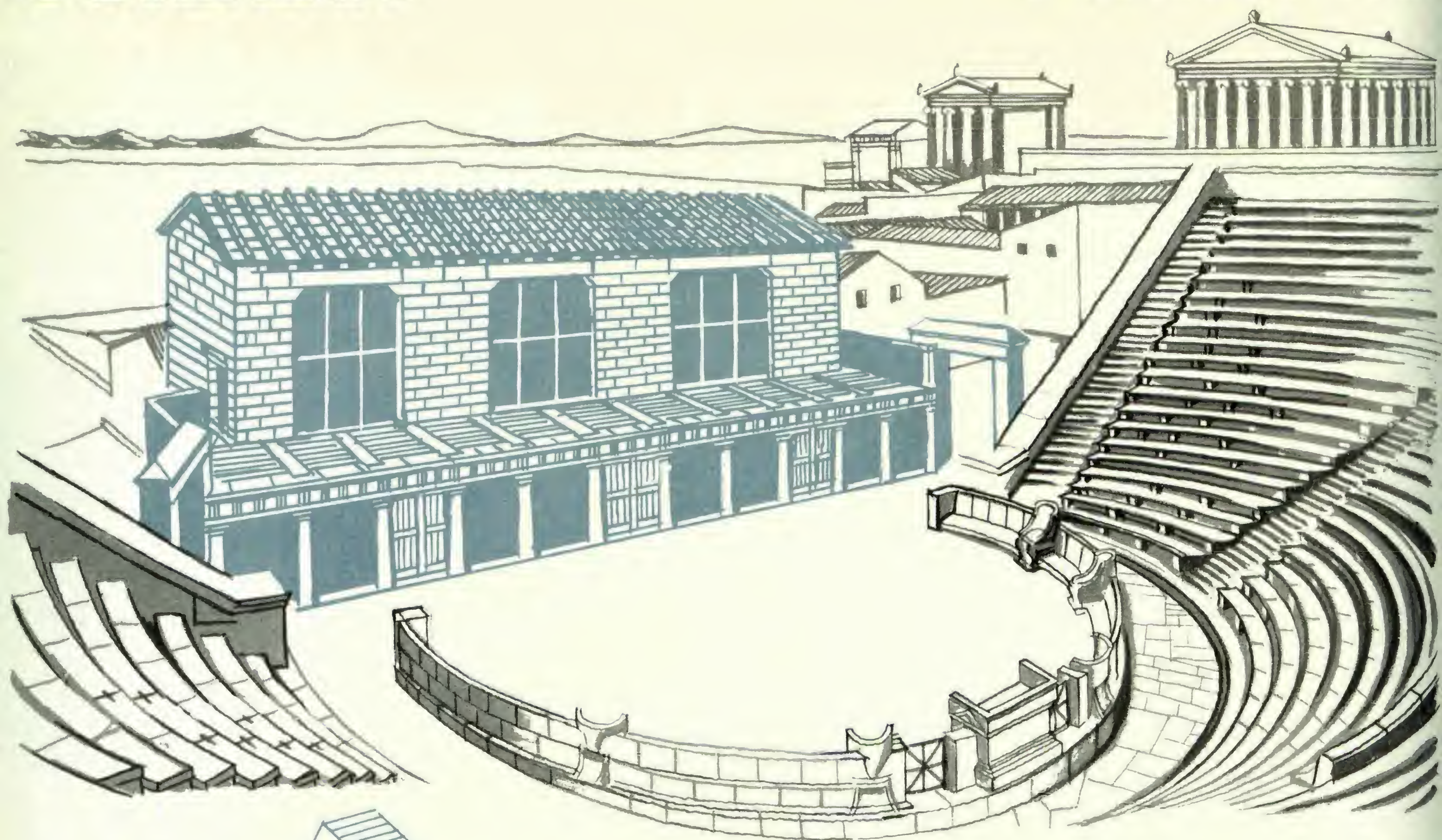
50

Temple of Bacchus



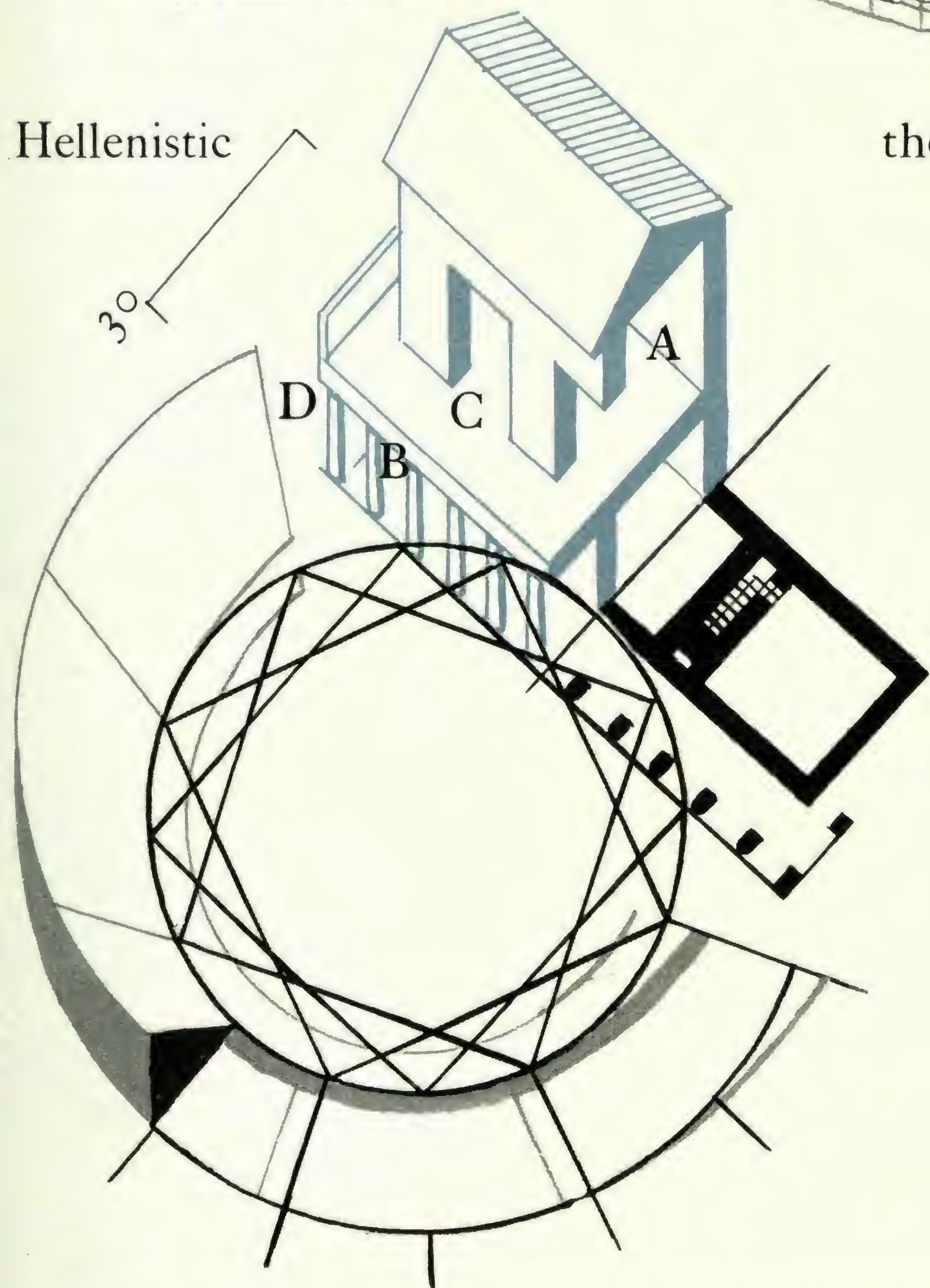
# GREEK

# THEATRE



Hellenistic

theatre, Priene, Asia Minor (restored), c. 50 B.C.



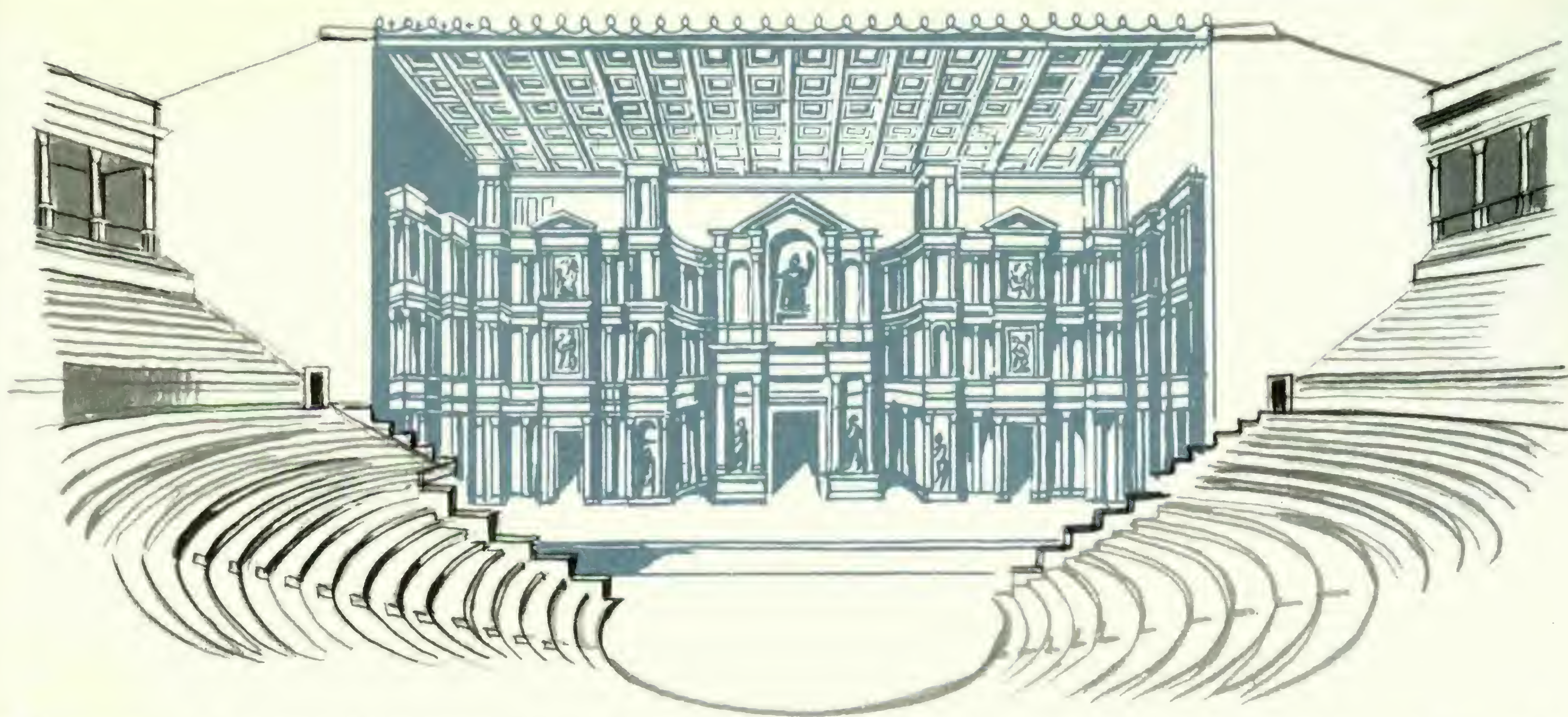
Plan of a Greek theatre based on 3 squares within the orchestra circle (Vitruvius, v.7)

The early Greek theatre consisted of an auditorium (simply a hill slope with stone seats), a semi-circular orchestra where the chorus sang and danced, and a wooden stage from which a single actor would hold a dialogue with the chorus. The number of actors was raised to two or three by Aeschylus (525-456 B.C.) and Sophocles (495-406 B.C.), who also introduced painted scenery and a dressing hut or skene. In the 4th century B.C. a wooden skene A was erected with a proscenium B having a row of columns, usually Doric, 8-12 ft from the skene wall supporting a stage of planks called the logeion or speaking-place C. Three doors in the skene wall were for entrances and exits of actors. At the two ends of the proscenium were the parodoi or open passage-ways D.



# ROMAN

# THEATRE



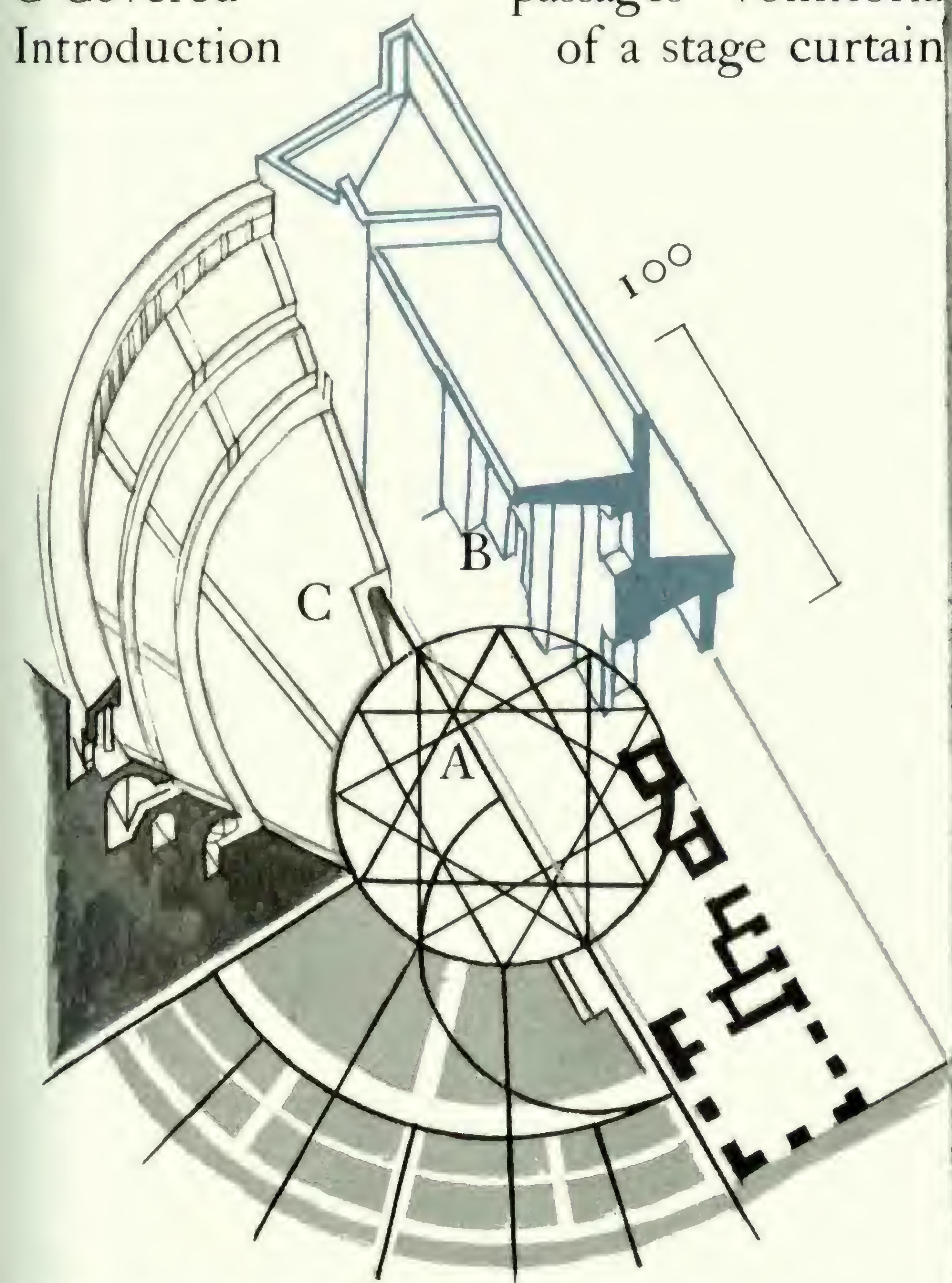
The Theatre, Orange (restored), c.A.D.50. Designed to seat 7000. Stage 5 ft high, 23 ft deep.

Built up on stone and concrete piers.

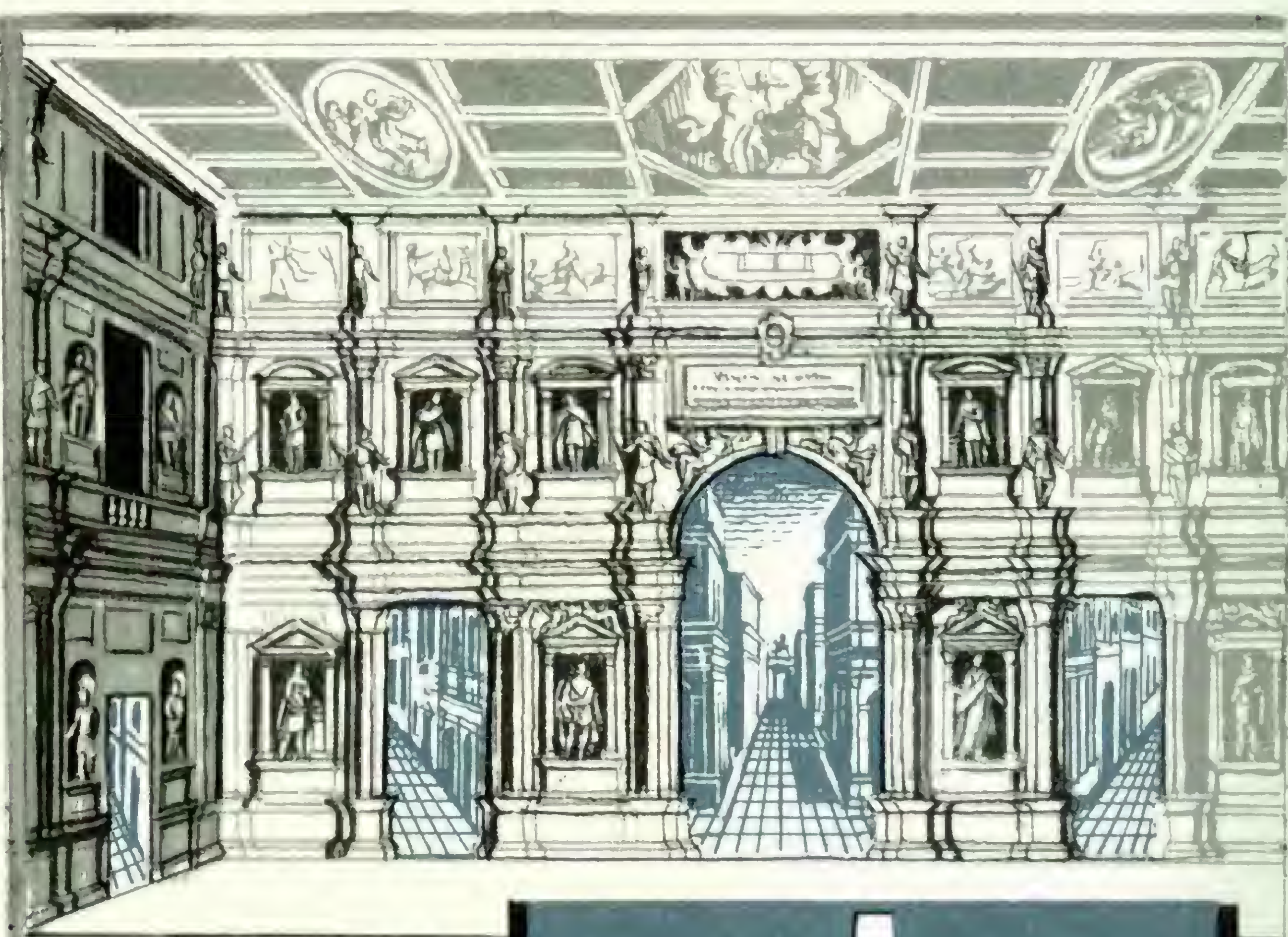
A Semi-circular cavea or auditorium

B Proscenium replaced by a frons scaenae

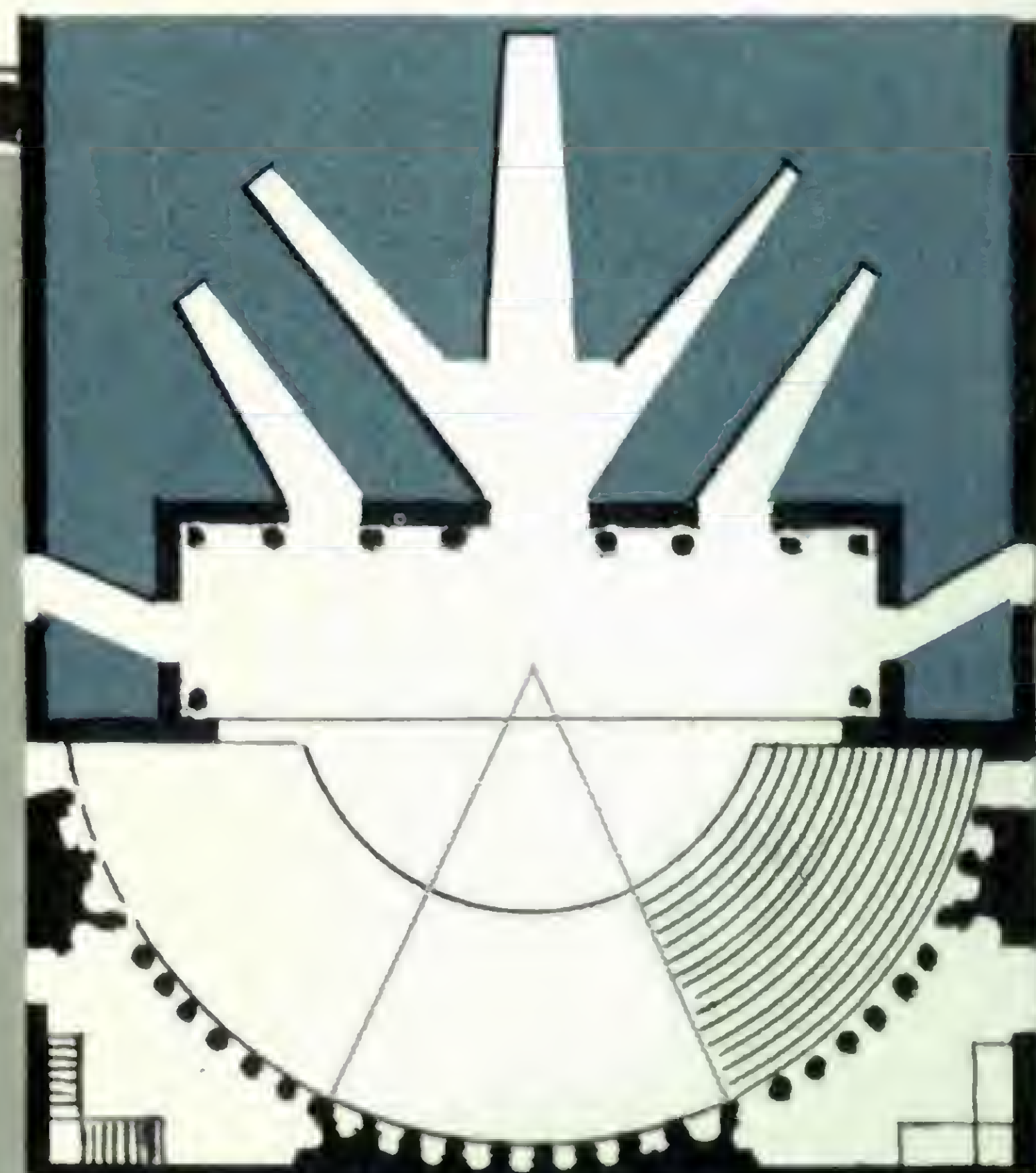
C Covered passages—vomitoria  
Introduction of a stage curtain



Plan of a Roman theatre based on 4 equilateral triangles in a circle (Vitruvius v,6)



A Renaissance adaptation of a Roman theatre. The Teatro Olimpico, Vicenza, Italy, designed by Palladio and completed by Scamozzi, A.D. 1584

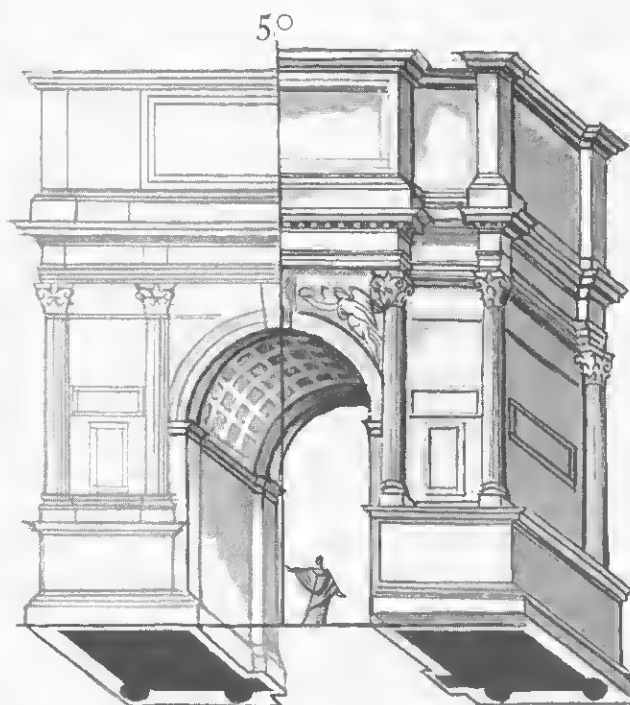




# ROMAN



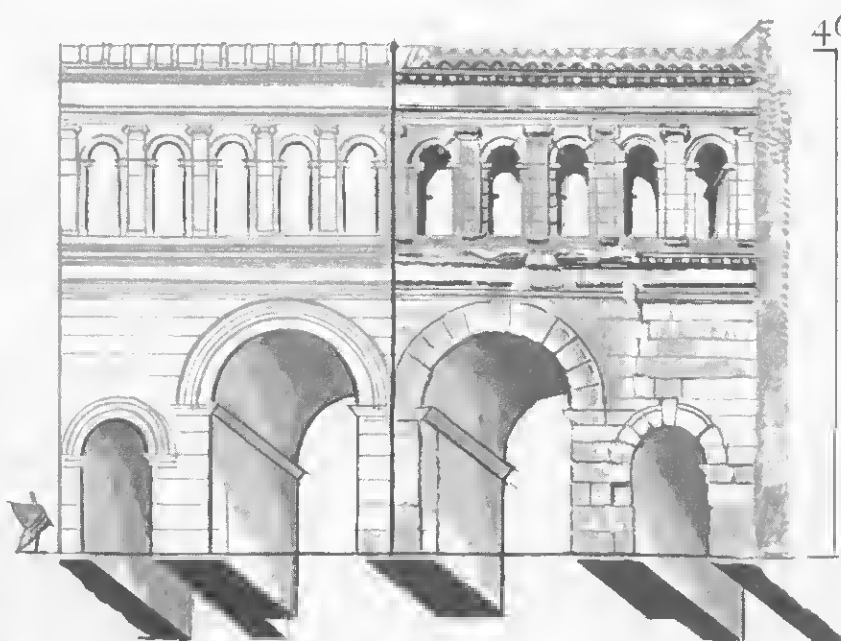
Triumphal Arches with one opening  
Arch of Augustus, Susa,  
Piedmont, c. A.D. 8



Arch of Titus, Rome, A.D. 70  
Earliest use of the Composite order.



Tomb of the Julii,  
Provenç, S. Remy,  
c. 30 B.C.-A.D. 14



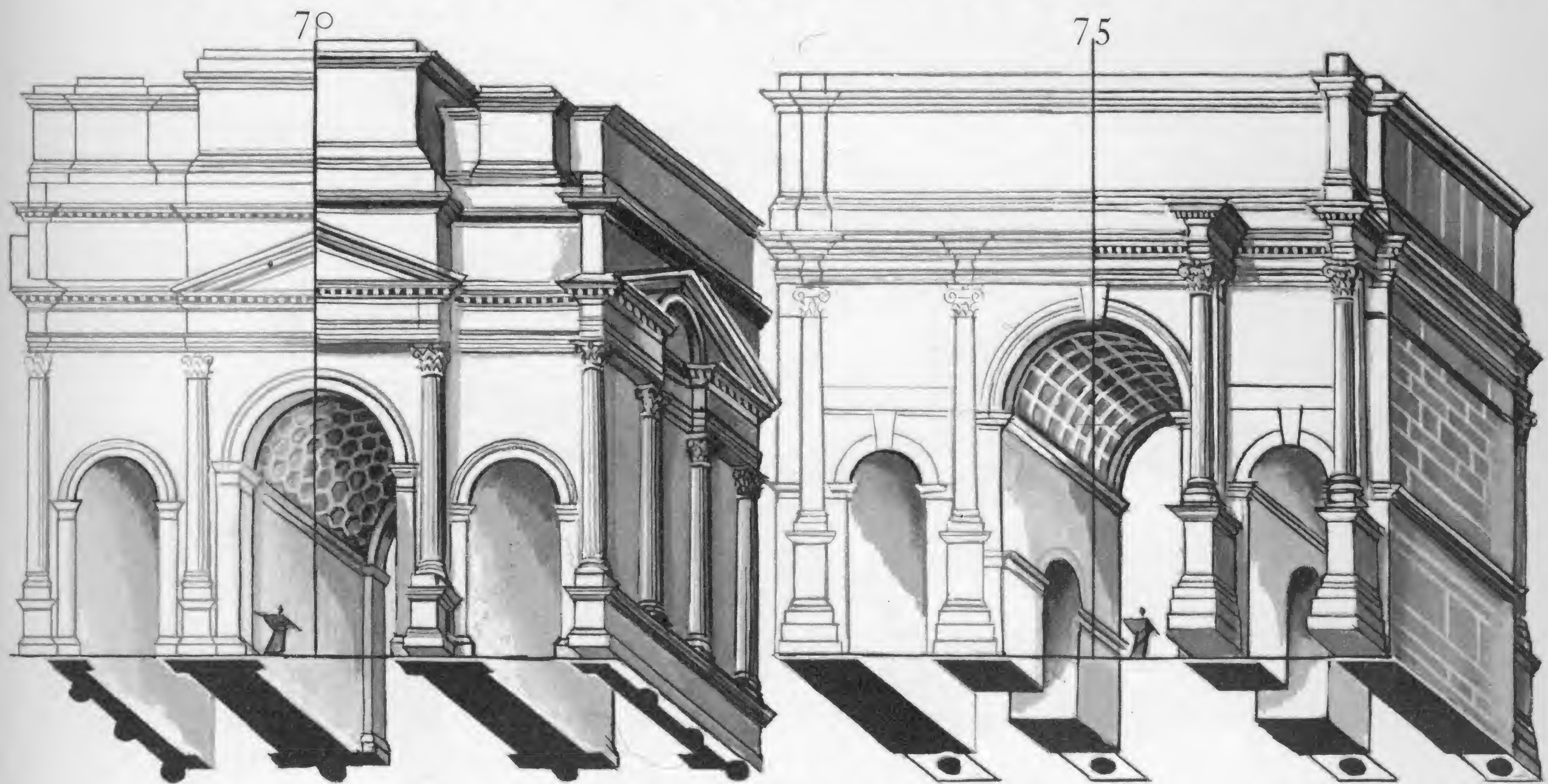
Town gateway with four archways  
The Porte S. André, Augustodunum (Autun).  
An arcaded gallery with Ionic pilasters creates  
an antiphonal response with the rise and fall  
of the large and small arches below



Trajan's  
Column,  
Rome,  
A.D. 114.



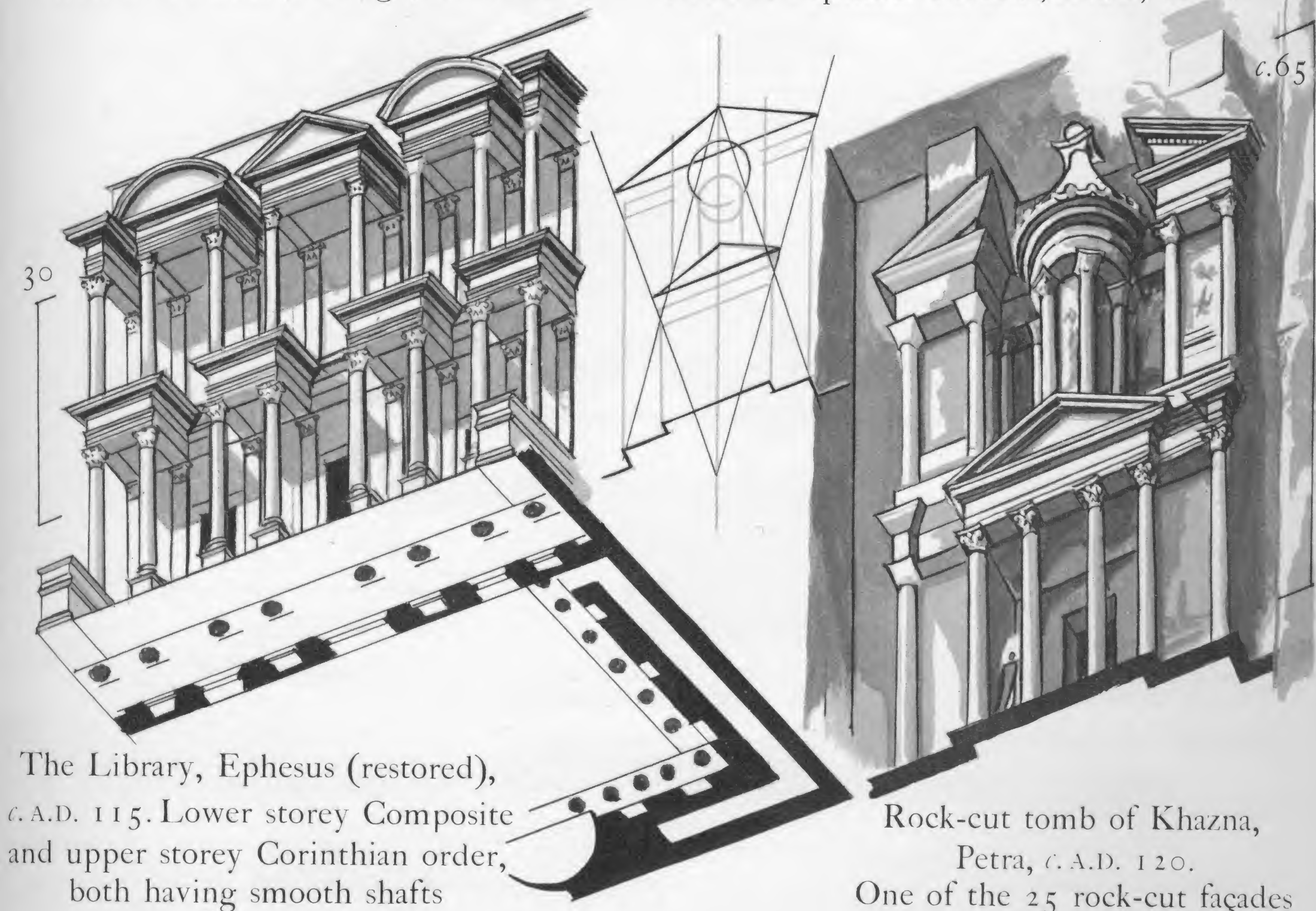
# ARCHES AND MONUMENTS



Triumphal Arches with three openings.

Arch of Tiberius, Orange, c. A.D. 21

Arch of Septimius Severus, Rome, A.D. 200

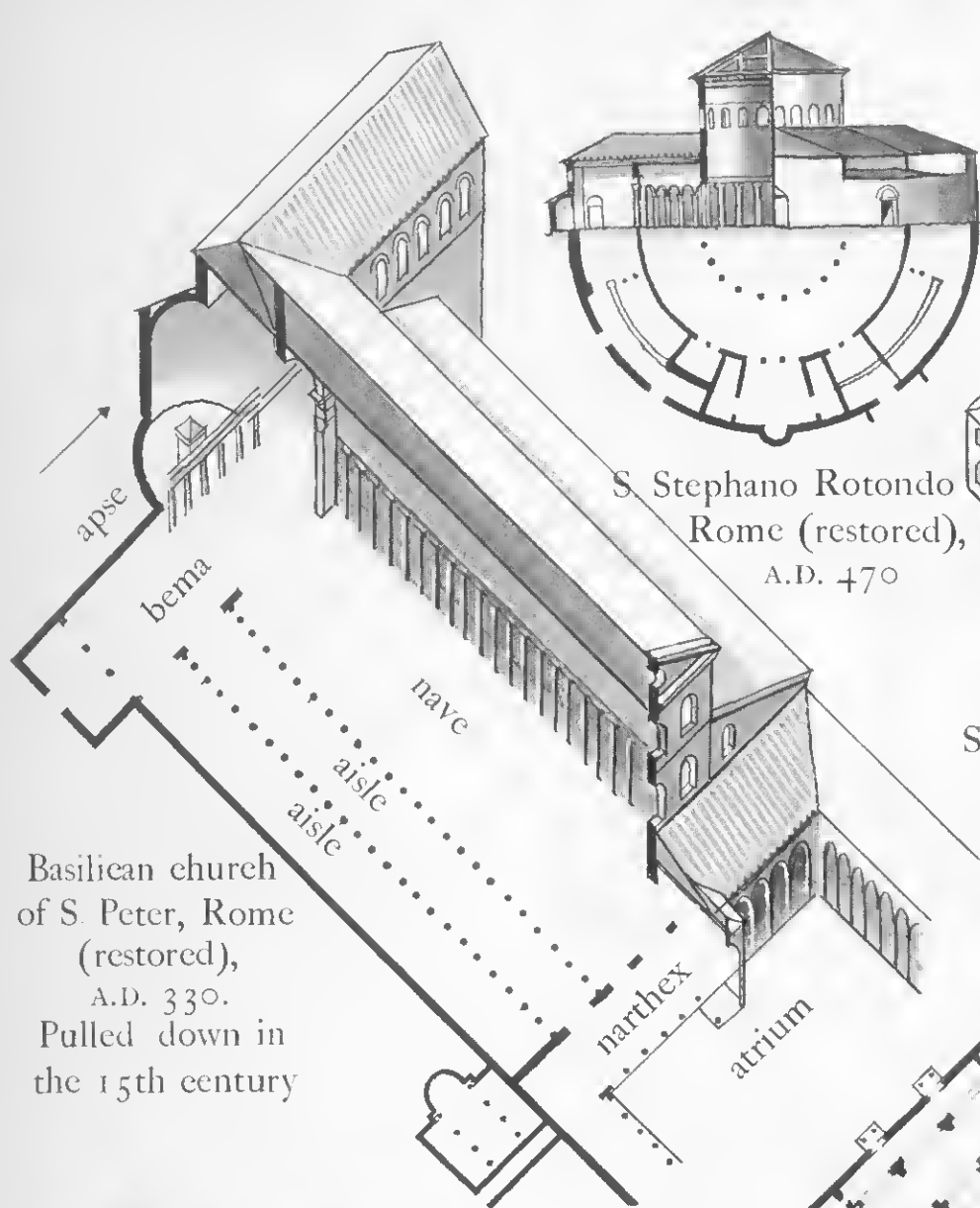


The Library, Ephesus (restored),  
c. A.D. 115. Lower storey Composite  
and upper storey Corinthian order,  
both having smooth shafts

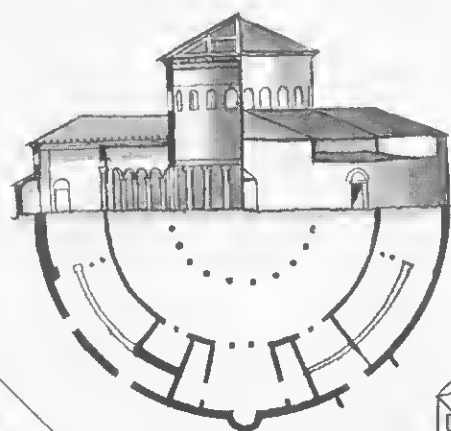
Rock-cut tomb of Khazna,  
Petra, c. A.D. 120.  
One of the 25 rock-cut façades



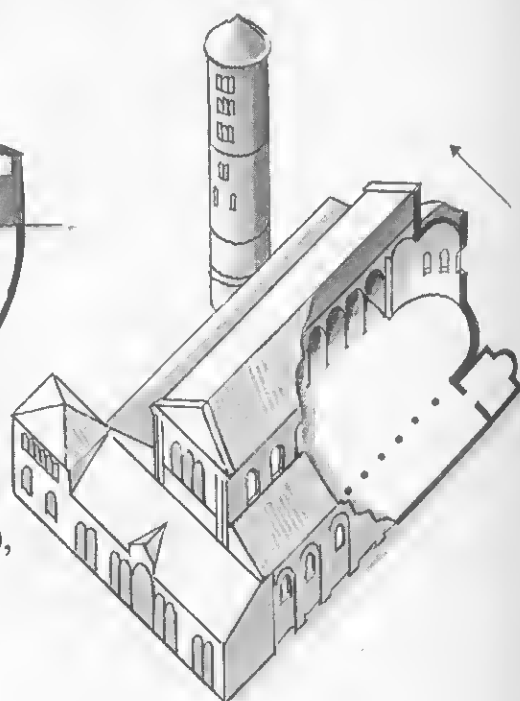
# EARLY CHRISTIAN



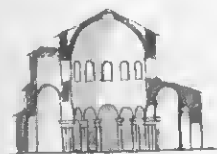
Basilican church  
of S. Peter, Rome  
(restored),  
A.D. 330.  
Pulled down in  
the 15th century



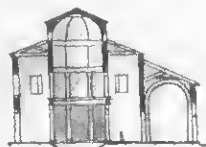
S. Stephano Rotondo  
Rome (restored),  
A.D. 470



S. Apollinare in Classe, Ravenna,  
A.D. 534-539



S. Costanza,  
Rome,  
A.D. 330

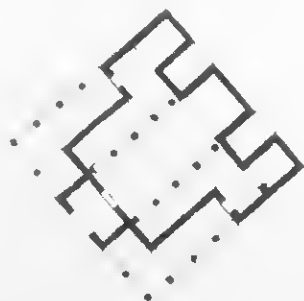


Baptistery of  
Constantine,  
Rome,  
A.D. 430-440

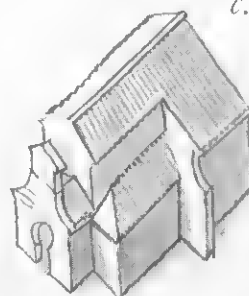
Syria,  
5th-6th centuries:  
churches built of large  
stone blocks and  
timber roofs



Church, Roueiha (restored),  
c. 6th century A.D.



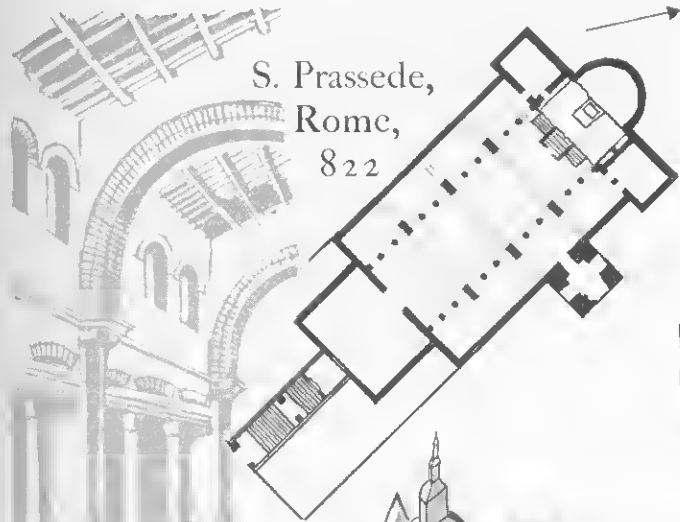
Visigothic before the Moslem invasion, with horse-shoe arch:  
S. Juan de Baños, Cerrato, Spain, c. A.D. 500-713



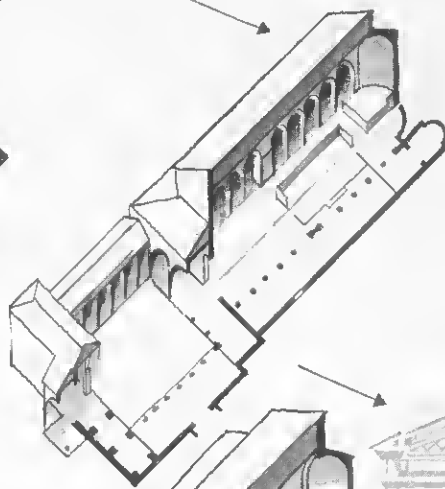


# COMPARATIVE PLANS

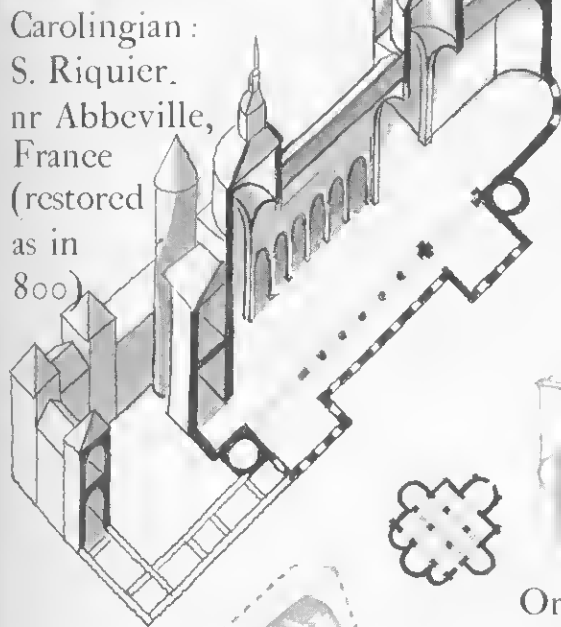
plans and sections in black to the same scale  150



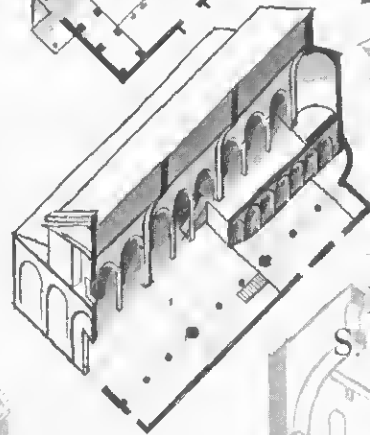
S. Prassede,  
Rome,  
822



S. Clemente, Rome,  
rebuilt 1084-1108 over  
a 4th-century church



Carolingian:  
S. Riquier,  
nr Abbeville,  
France  
(restored  
as in  
800)



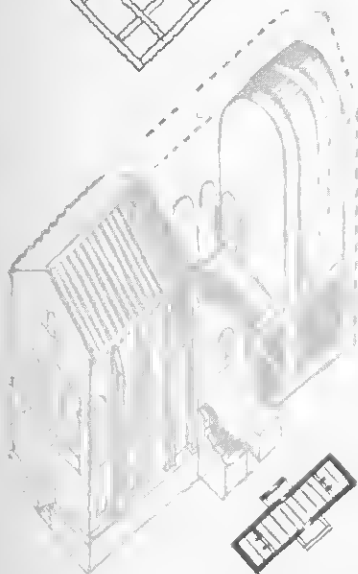
Early Christian-Romanesque:  
S. Miniato, Florence, A.D. 1013



Oratory,  
Germigny-des-Prés,  
France, A.D. 806



Spanish-Romanesque:  
S. Vicente de Cardona,  
Catalonia, c. 1024-1040



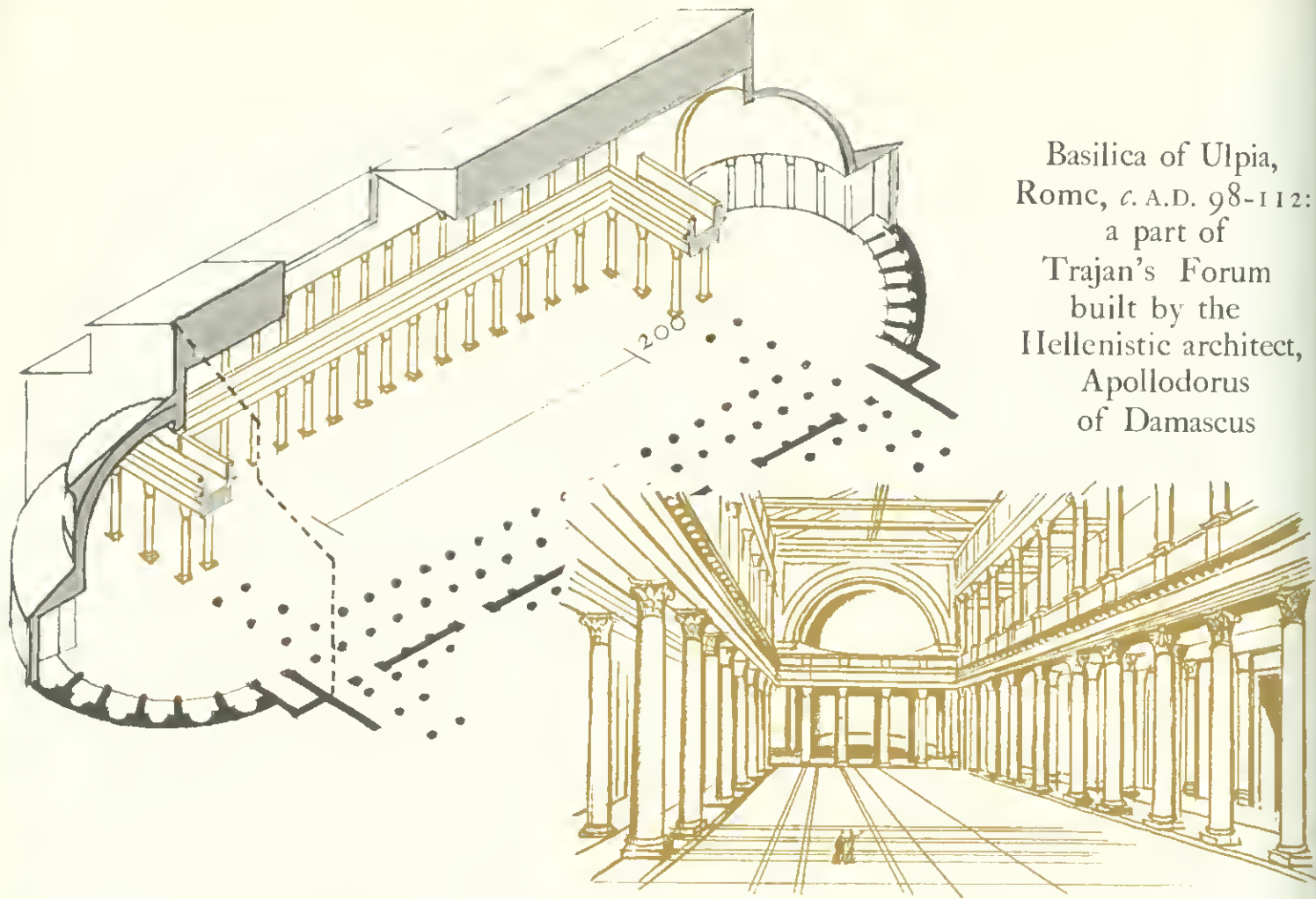
S. Maria de Naranco  
Asturia, Spain,  
A.D. 824-840



Mozarabic, 'Arabized Spanish':  
S. Miguel de Escalada, León, A.D. 913

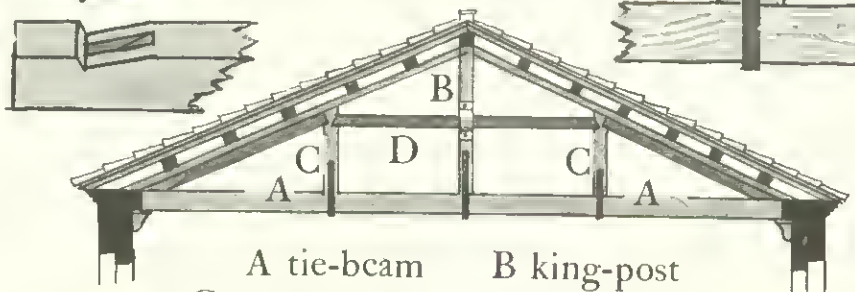
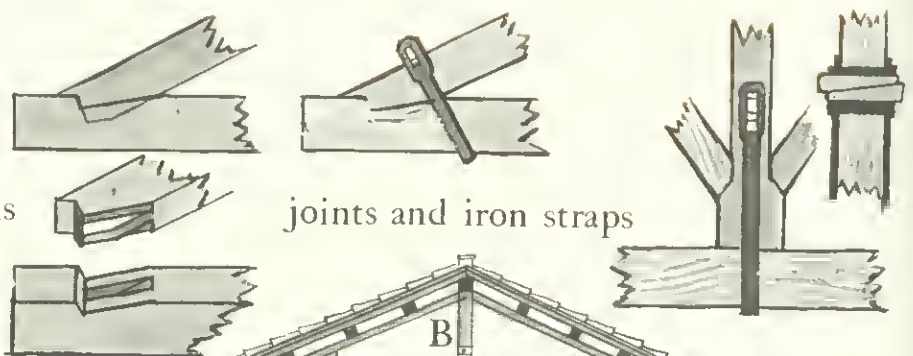
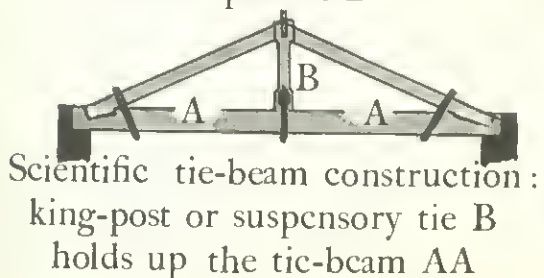
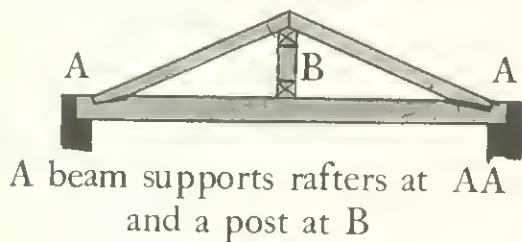
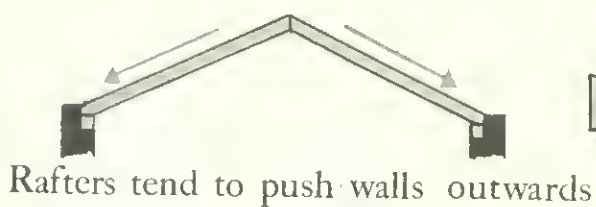


# ROMAN BASILICA EARLY

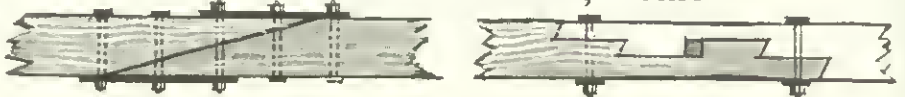


Basilica of Ulpia,  
Rome, c. A.D. 98-112:  
a part of  
Trajan's Forum  
built by the  
Hellenistic architect,  
Apollodorus  
of Damascus

## TIMBER ROOFS



S. Paolo fuori le Mura, Rome

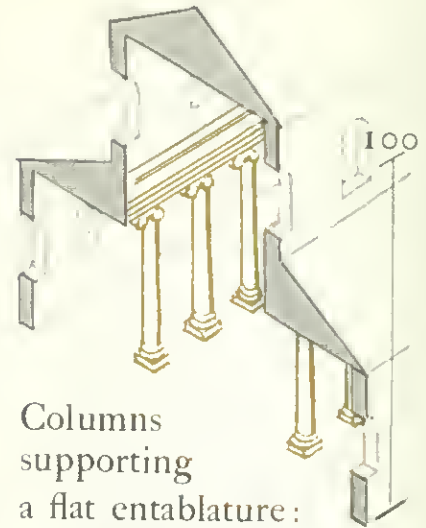
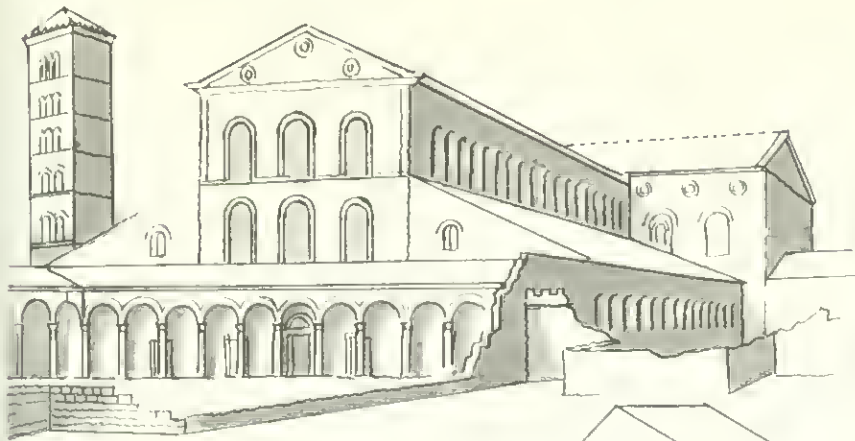


Tie-beams lengthened by scarf-joints and iron bolts

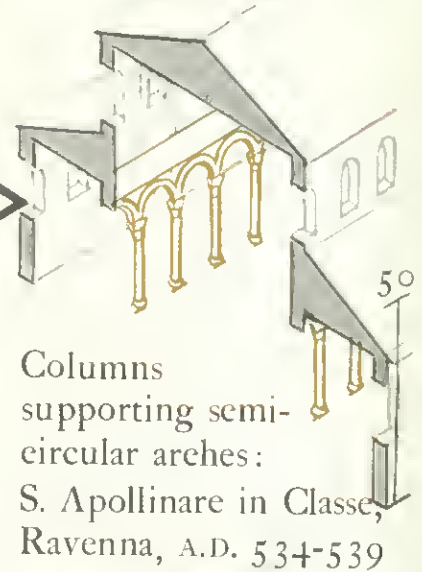
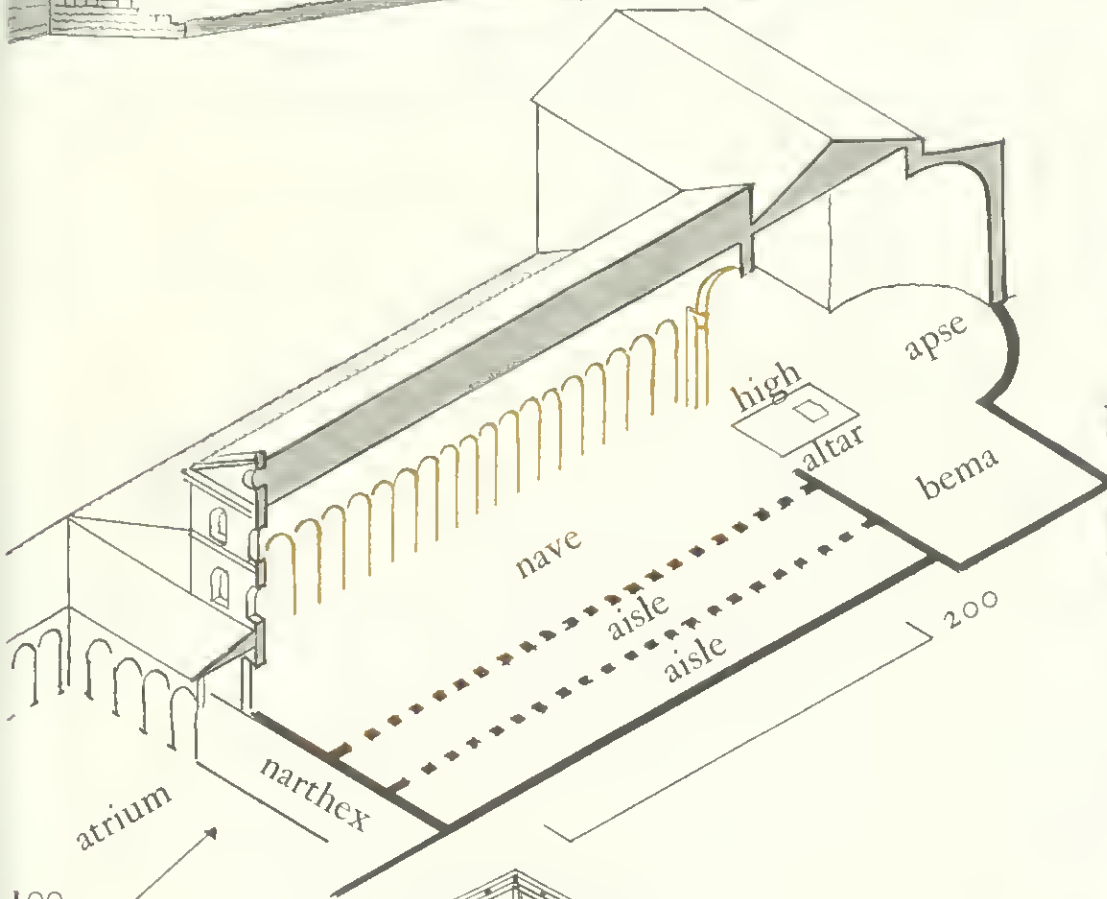


# CHRISTIAN

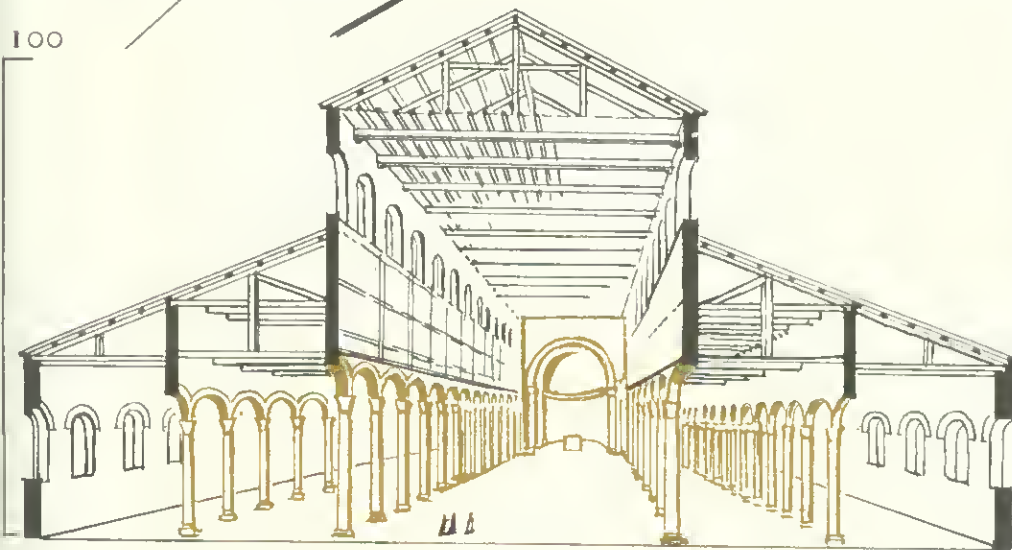
# CHURCHES



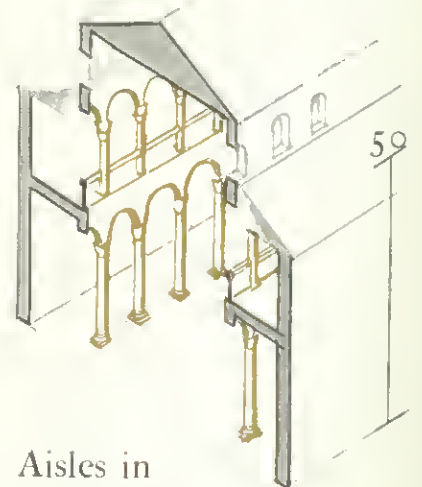
Columns supporting a flat entablature:  
S. Maria Maggiore, Rome, A.D. 432



Columns supporting semi-circular arches:  
S. Apollinare in Classe, Ravenna, A.D. 534-539



Basilican church of S. Paolo fuori le Mura, Rome, A.D. 320; burnt down in 1832 and rebuilt to the original design

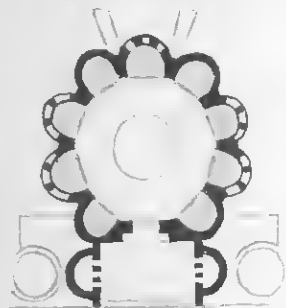
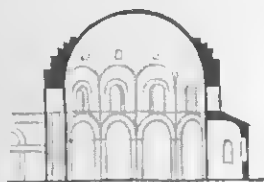


Aisles in two storeys:  
S. Agnese fuori le Mura, Rome, A.D. 625-638

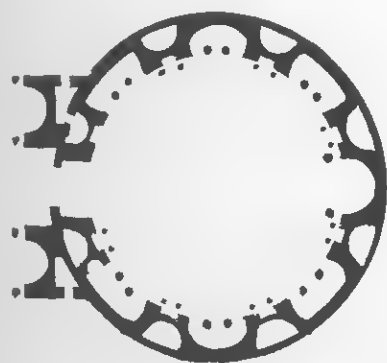
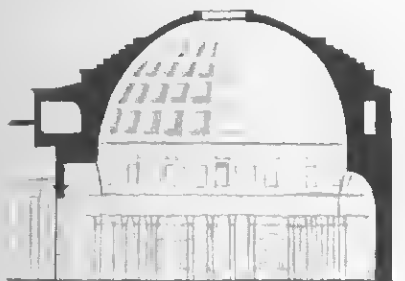


# BYZANTINE

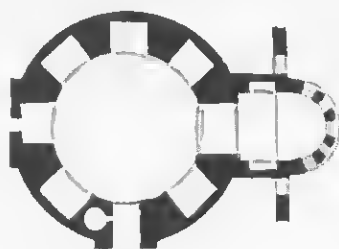
## ROMAN



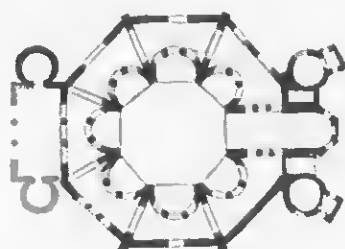
The Minerva Medica,  
Rome, c. A.D. 260



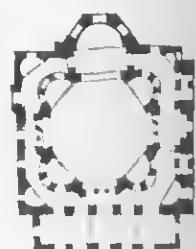
The Pantheon, Rome,  
A.D. 120-124



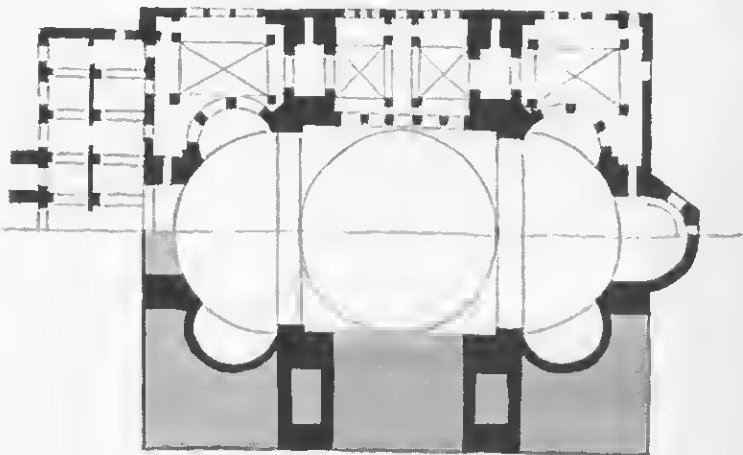
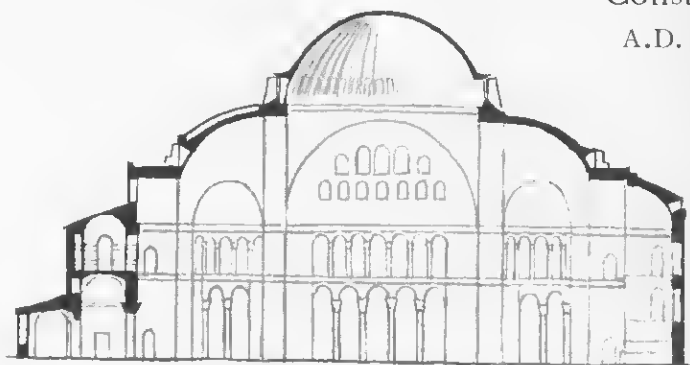
S. George, Salonika,  
c. A.D. 400



S. Vitale, Ravenna,  
A.D. 526-547

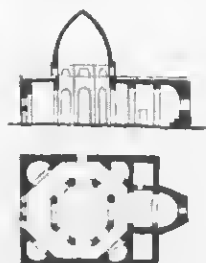
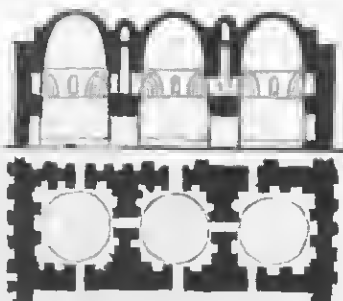


SS. Sergius  
and Bacchus,  
Constantinople  
A.D. 527-553



S. Sophia, Constantinople, A.D. 532-537

PERSIA:  
detail of Palaeo,  
Feruz-abad,  
A.D. 450

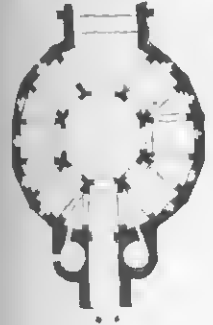
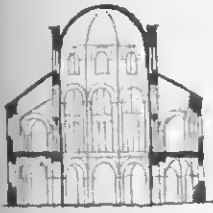


SYRIA:  
S. George,  
Ezra,  
c. A.D. 510

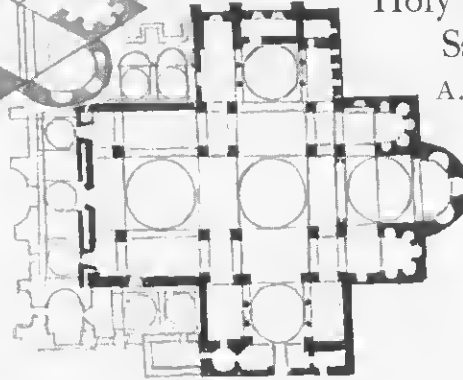
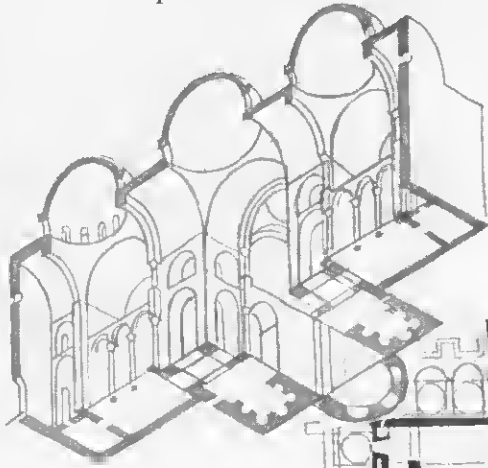


# COMPARATIVE PLANS

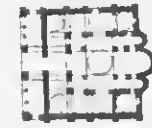
plans and sections in black to the same scale  150



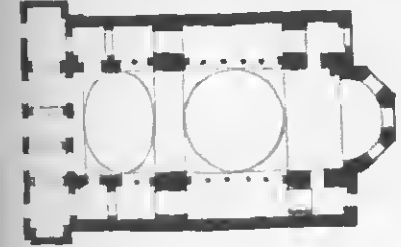
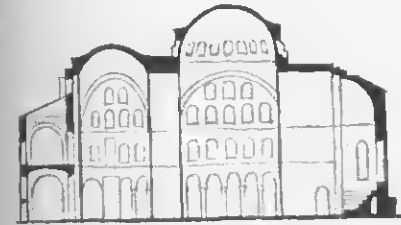
Carolingian  
cathedral,  
Aix-la-Chapelle,  
A.D. 796-804



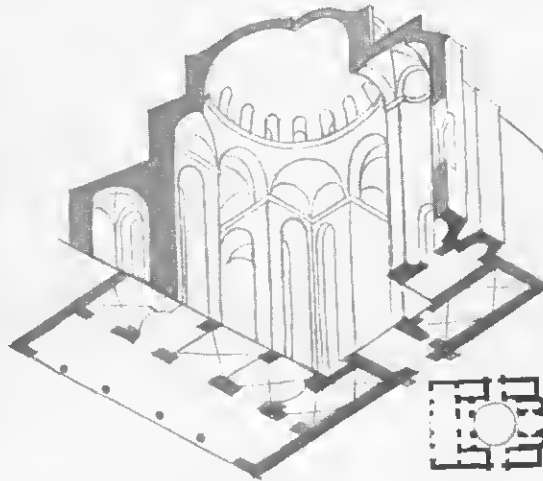
S. Mark, Venice, A.D. 1042-1085



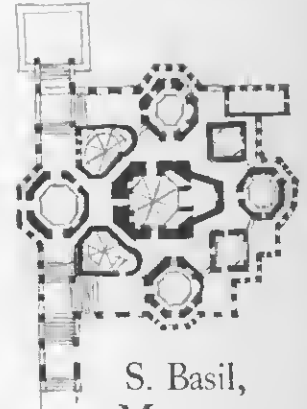
Holy Apostles,  
Salonika,  
A.D. 1200



S. Irene, Constantinople,  
A.D. 740



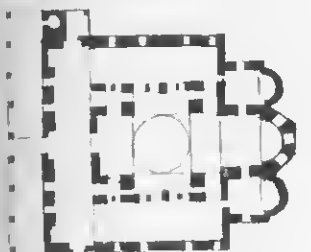
Church, Daphni, nr Athens,  
c. 11th century A.D.



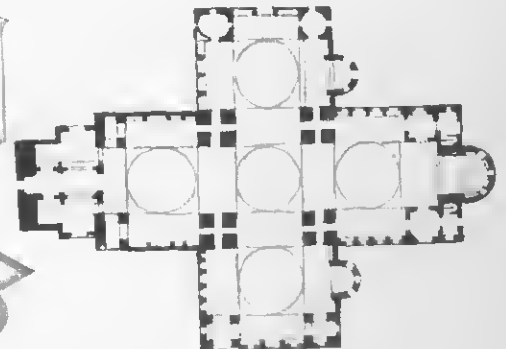
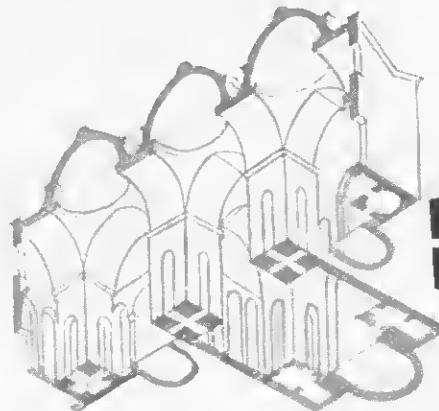
S. Basil,  
Moscow,  
A.D. 1554-1560



S. Saviour  
Pantepoptes,  
Constantinople,  
early 12th century



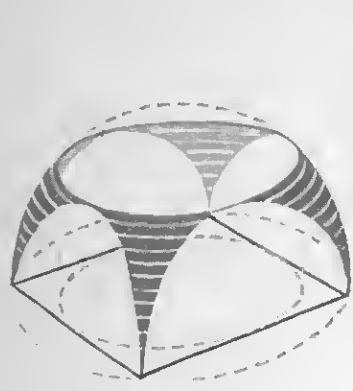
S. Sophia, Salonika,  
c. 6th century A.D.



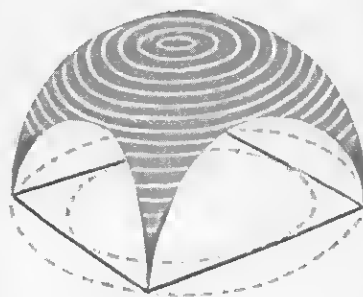
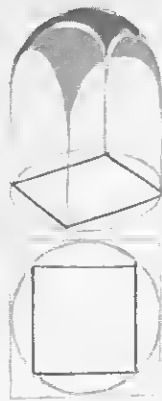
S. Front, Perigueux, France, A.D. 1120



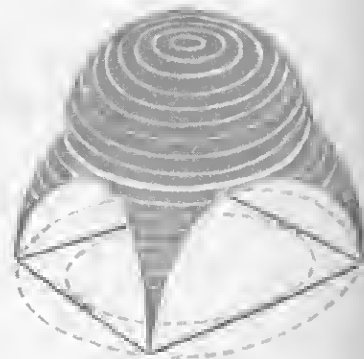
# BYZANTINE



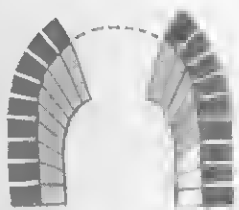
Pendentives



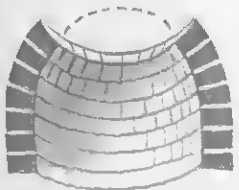
Dome and pendentives  
parts of one hemisphere



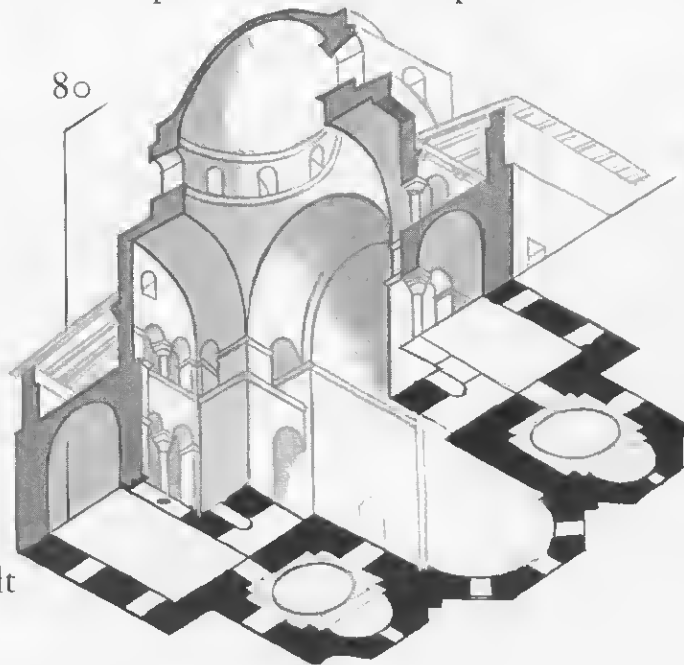
The dome a hemisphere  
set above pendentives



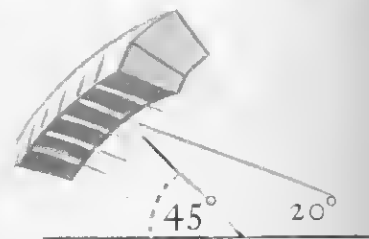
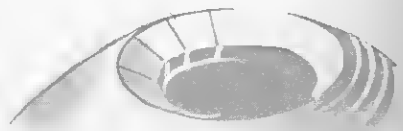
To build an arch  
centering is necessary,



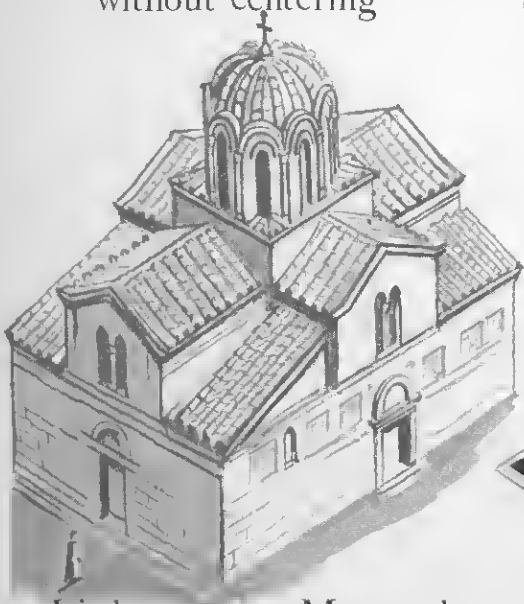
but a dome can be built  
in successive rings  
of horizontal arches  
without centering



S. Sophia, Salonika, c. A.D. 495

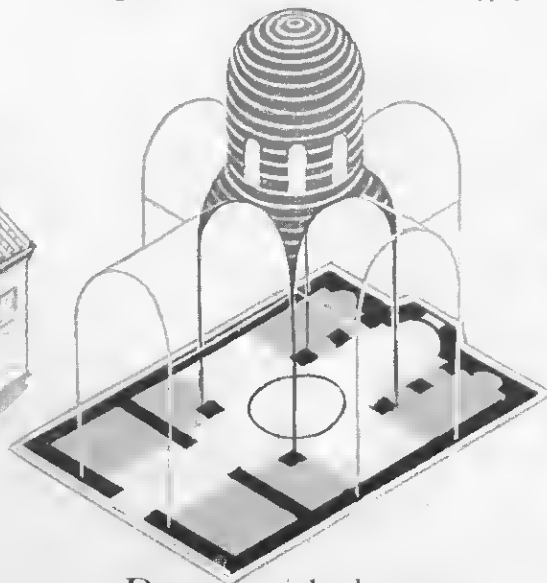


Domes on pendentives  
built with bricks  
not radiating  
from centre

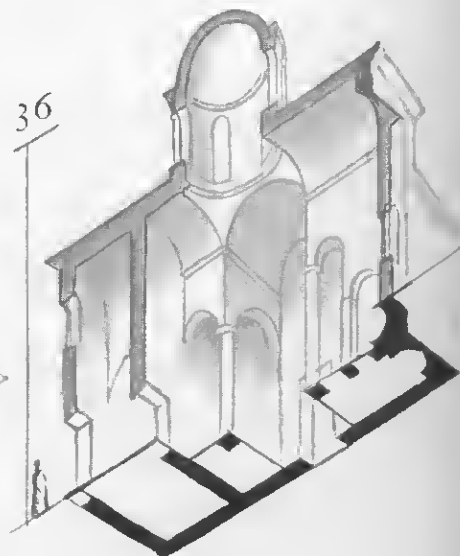


Little  
Cathedral,

Metropole  
Athens, A.D. 1250

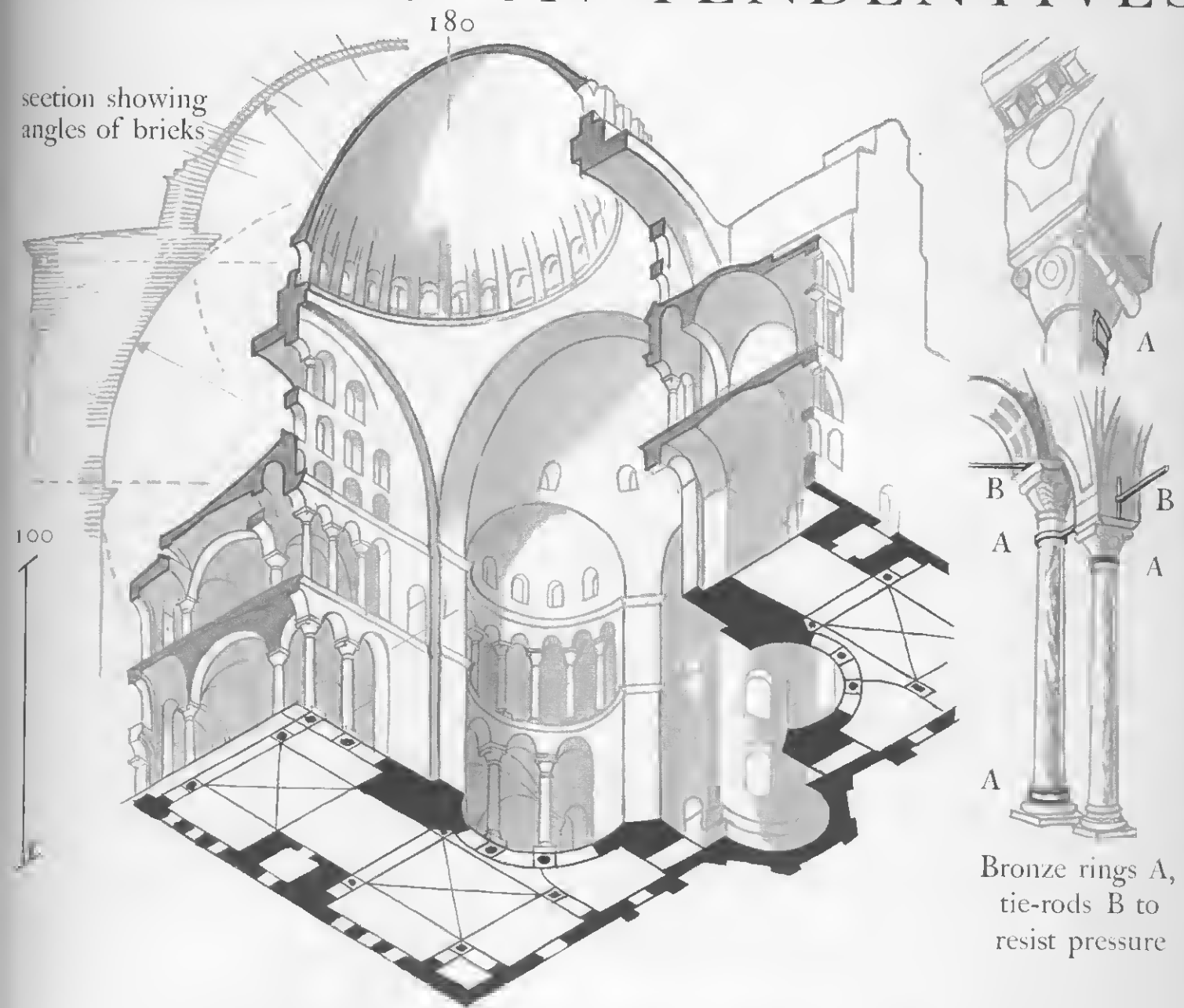


Dome with drum:  
cross-in-square plan



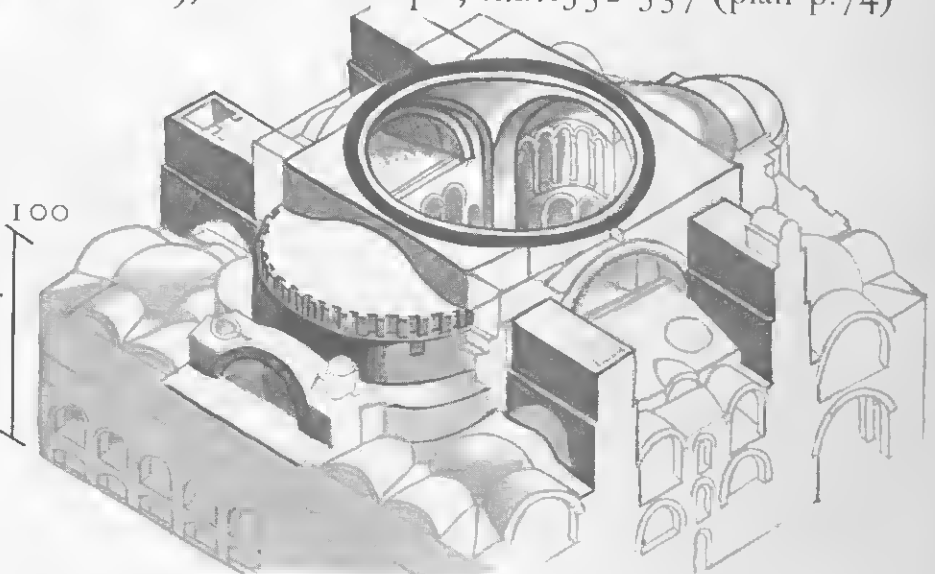


# DOMES ON PENDENTIVES



S. Sophia (Hagia Sophia = divine wisdom), Constantinople, A.D. 532-537 (plan p.74)

Built for Justinian by two Greek architects, Anthemius of Tralles and Isidorus of Miletus. Built of brick; the dome probably erected without centering, with bricks about 24-27 inches square and 2 inches thick laid in deep mortar and covered with  $\frac{1}{4}$  inch lead; the dome supported on 4 piers, the thrust being taken by 2 semi-domes and 4 massive buttresses; the interior lined throughout in coloured marbles and mosaics





# ROMANESQUE

plans and elevations  
to the same scale

200

## ITALY

S. Miniato, Florence, 1062

## FRANCE

Pisa Cathedral, 1063-1272

S. Riquier,  
nr Abbeville  
(restored), c. 799

S. Philibert, Tournus,  
c. 950-1120 & later

Abbaye-aux-  
Hommes (S. Etienne),  
Caen, 1066-1077

## GERMANY

S. Cyriacus, Gernrode,  
961 and later

Speyer Cathedral  
1031-61 & 12th century

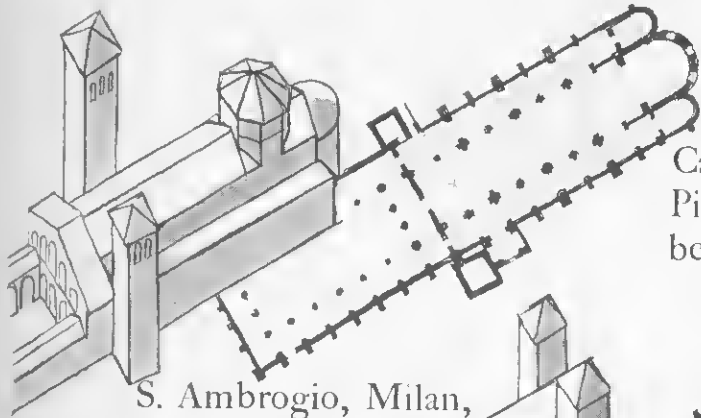
## SPAIN

Ripoll Abbey,  
Catalonia, 1020-1032

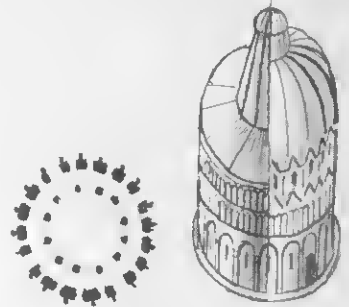
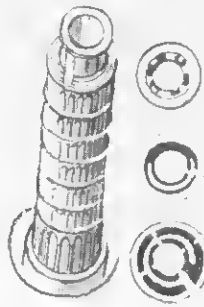
Santiago de Compostela,  
c. 1075-1121: pilgrimage church similar in plan  
to Tours, Limoges, Conques and Toulouse



# PLANS & ELEVATIONS



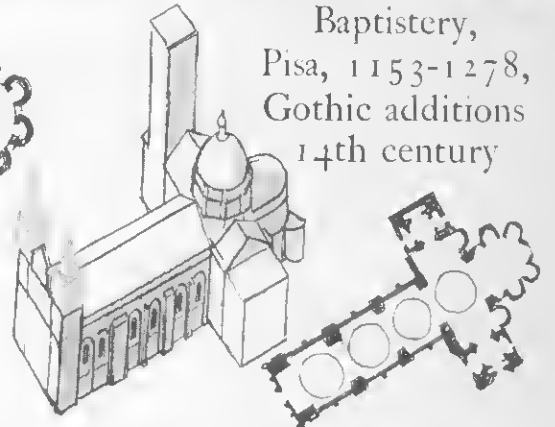
Campanile,  
Pisa, 1174;  
belfry 1350



Baptistry,  
Pisa, 1153-1278,  
Gothic additions  
14th century

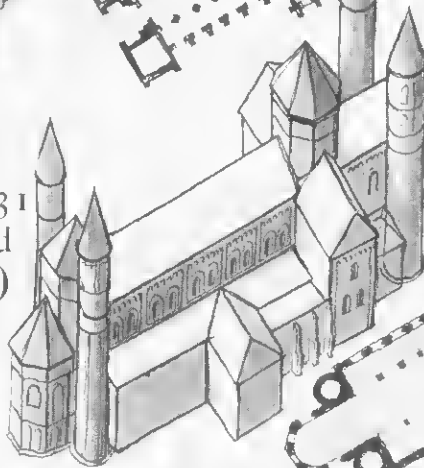


Cluny Abbey III  
(restored), 1088-1131  
(elevation reversed  
to show the apse)

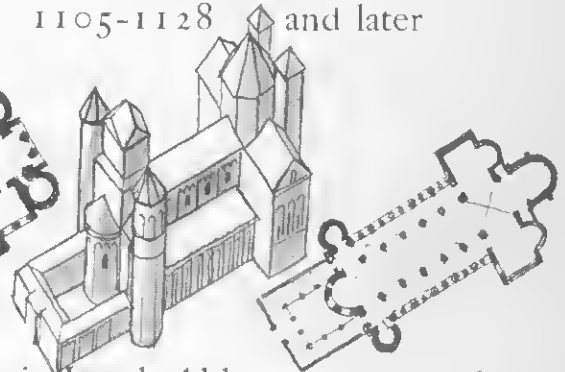


Angoulême Cathedral,  
1105-1128 and later

## GERMANY

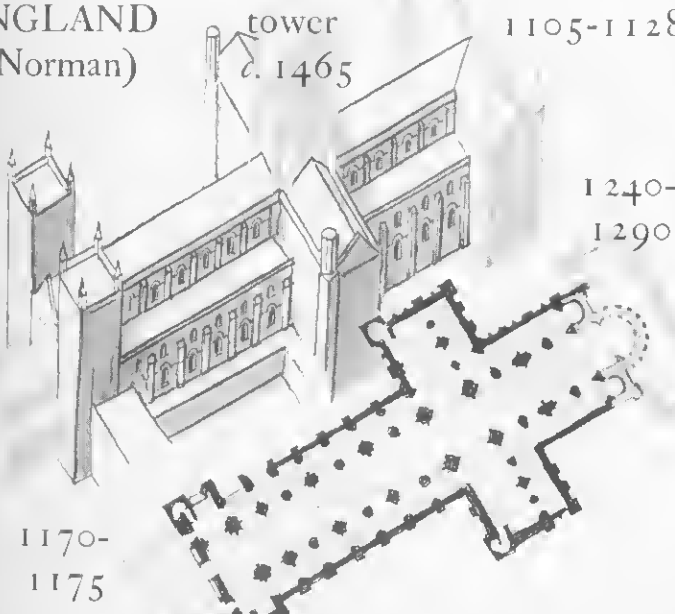


Worms Cathedral,  
1105-1128 and later



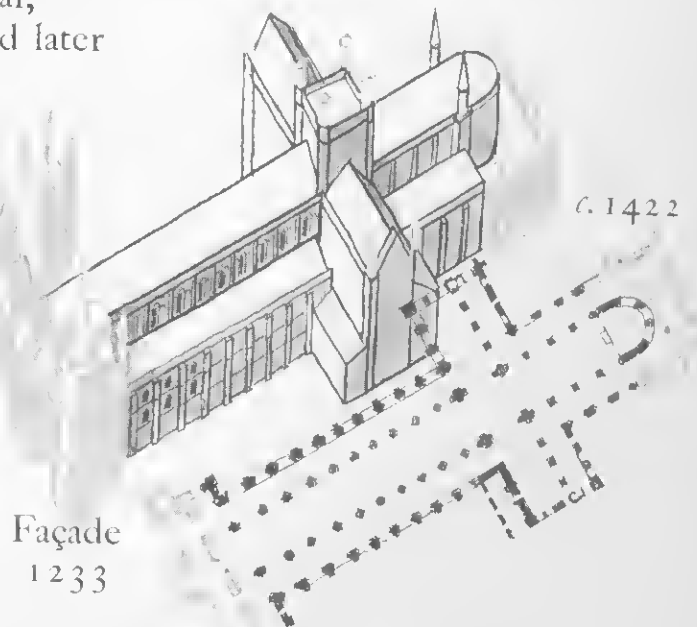
Maria Laach Abbey, 1093-1156

## ENGLAND (Norman)



1170-  
1175

Durham Cathedral, 1093-1133



Façade  
1233

Peterborough Cathedral, 1177-1190

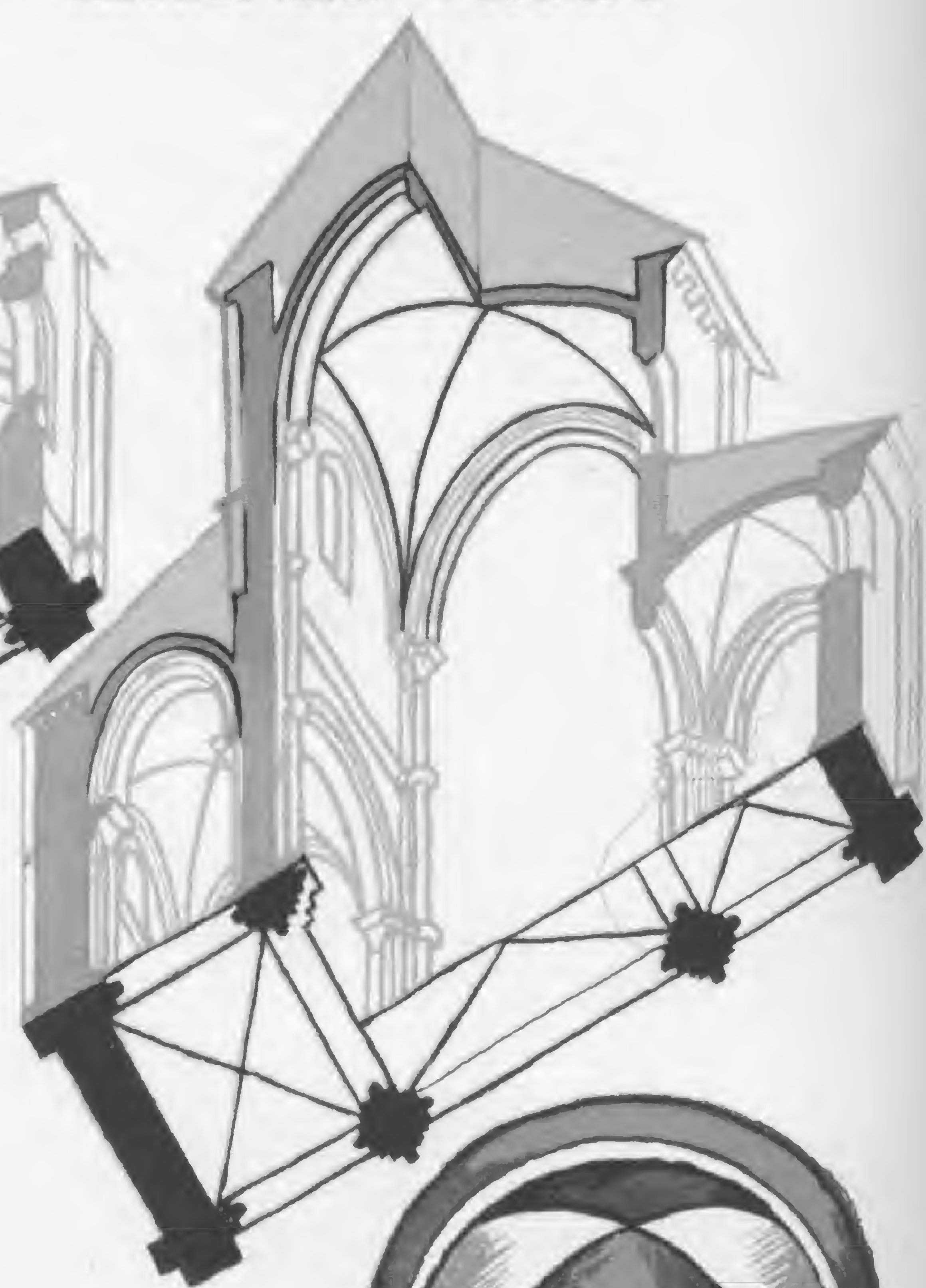


# ROMANESQUE

scale for  
sections  
5°

## BARREL VAULTS

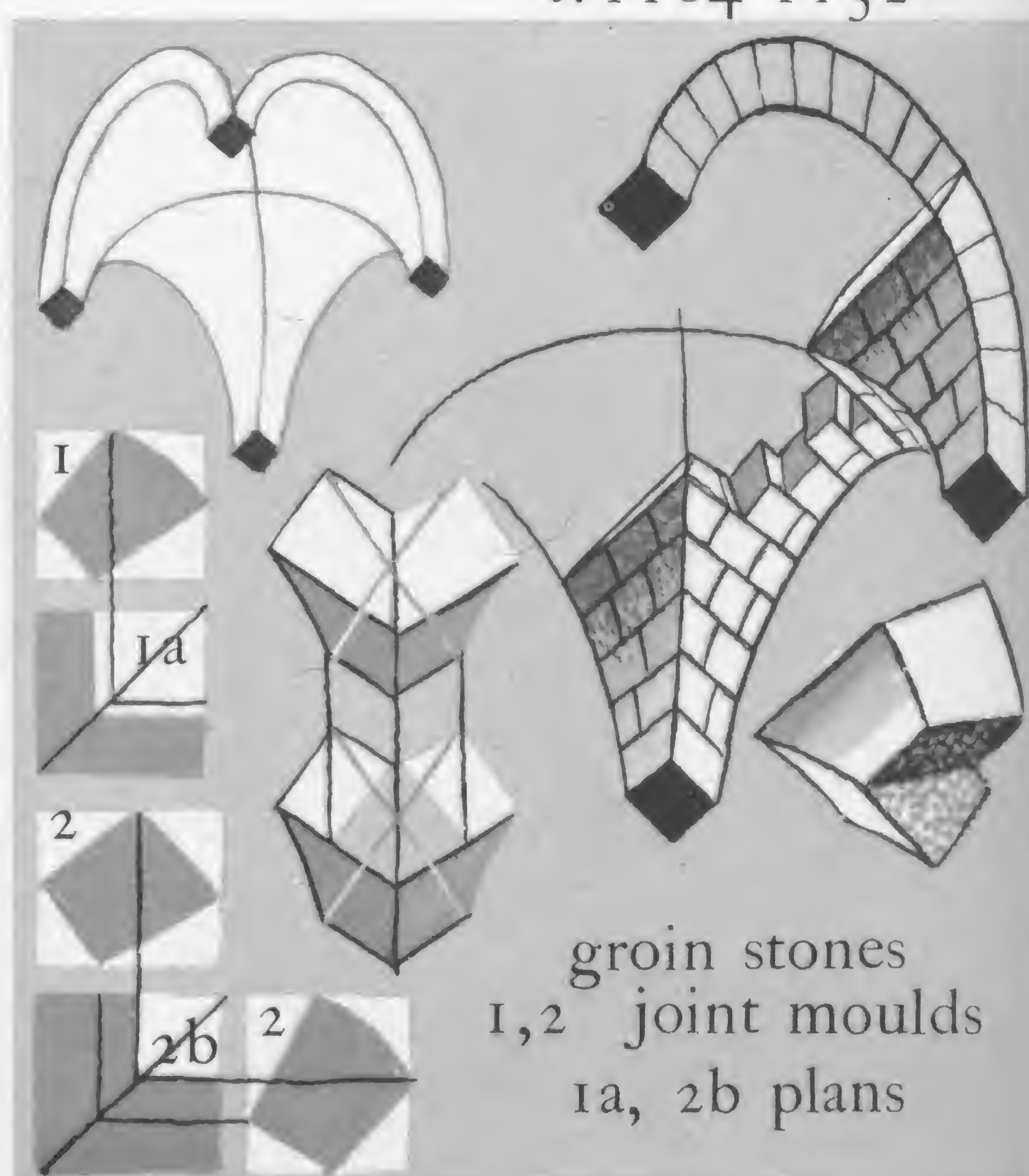
## GROINED VAULT



S. Savin-sur-Gartempe,  
c. 1060-1115

S. Sernin, Toulouse,  
1080-1096

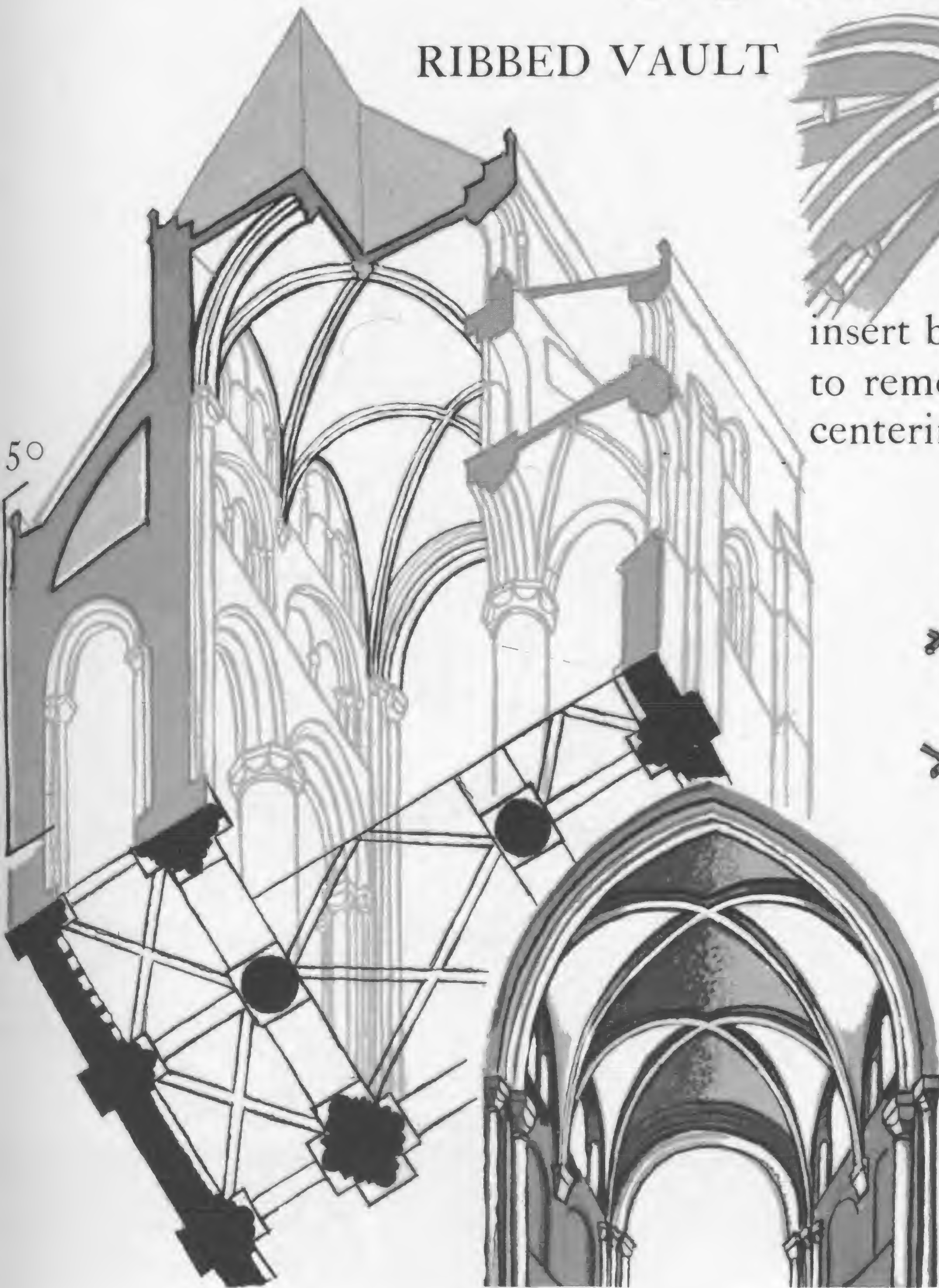
S. Madelaine, Vézelay,  
c. 1104-1132



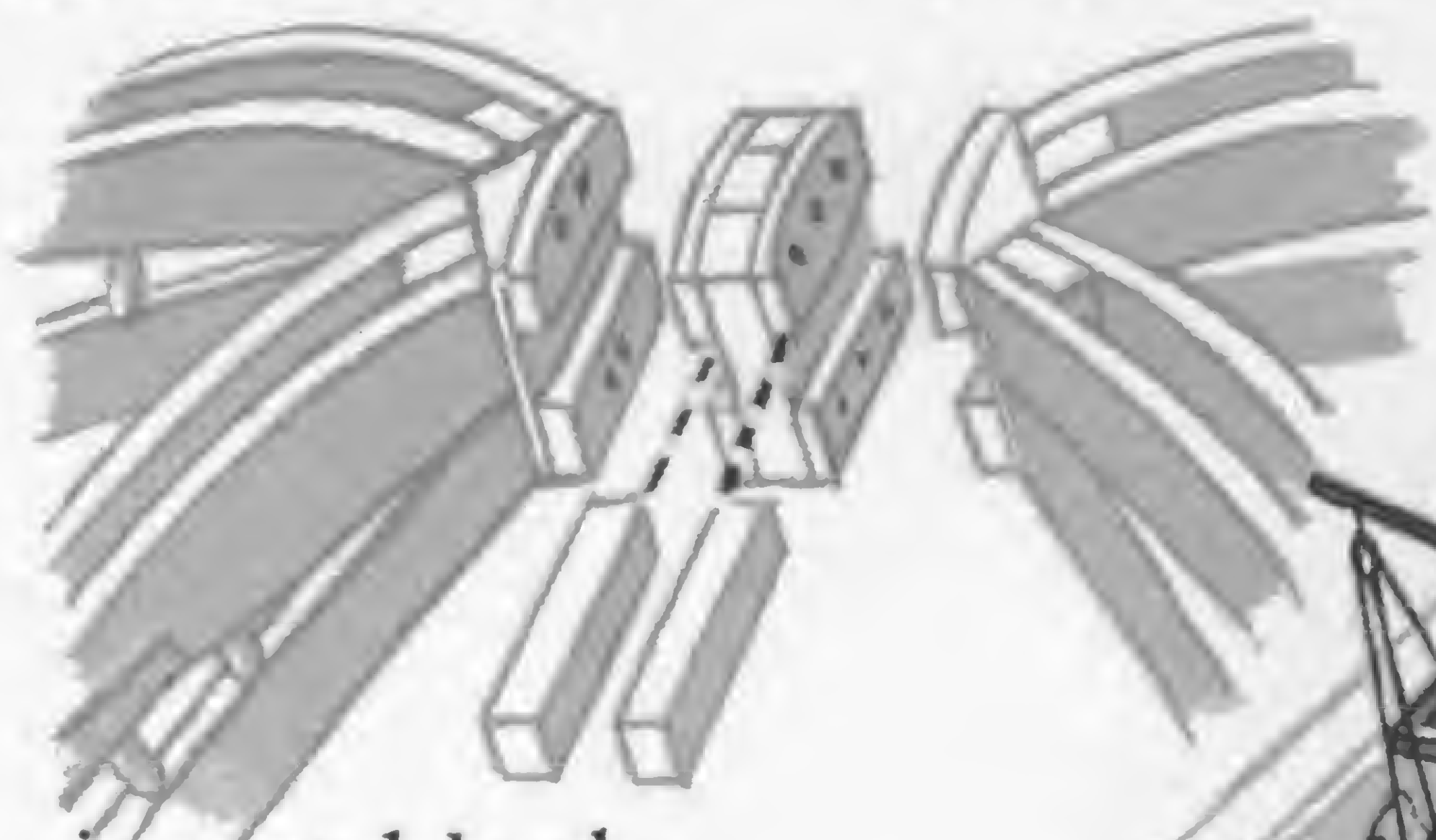


# STONE VAULTING

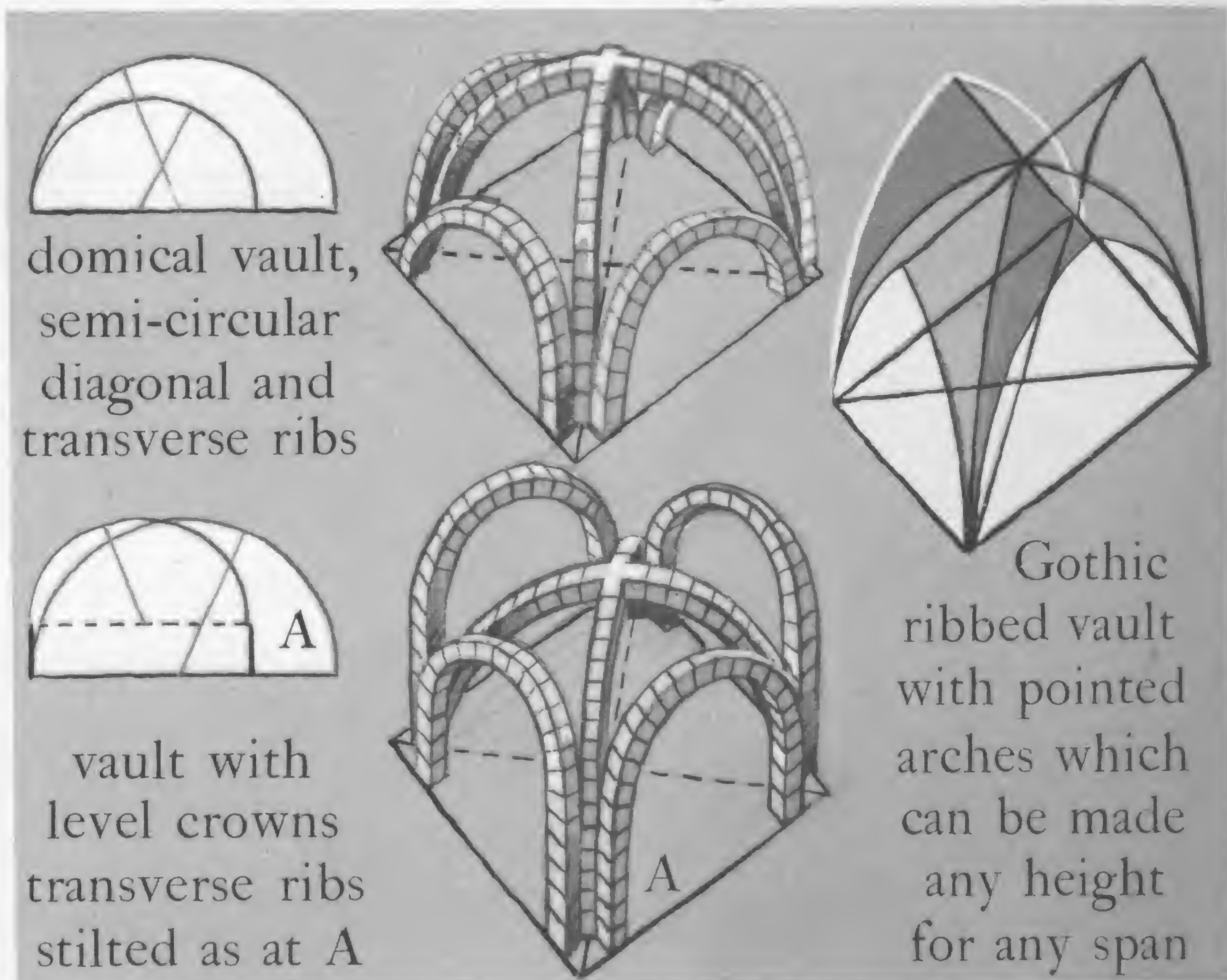
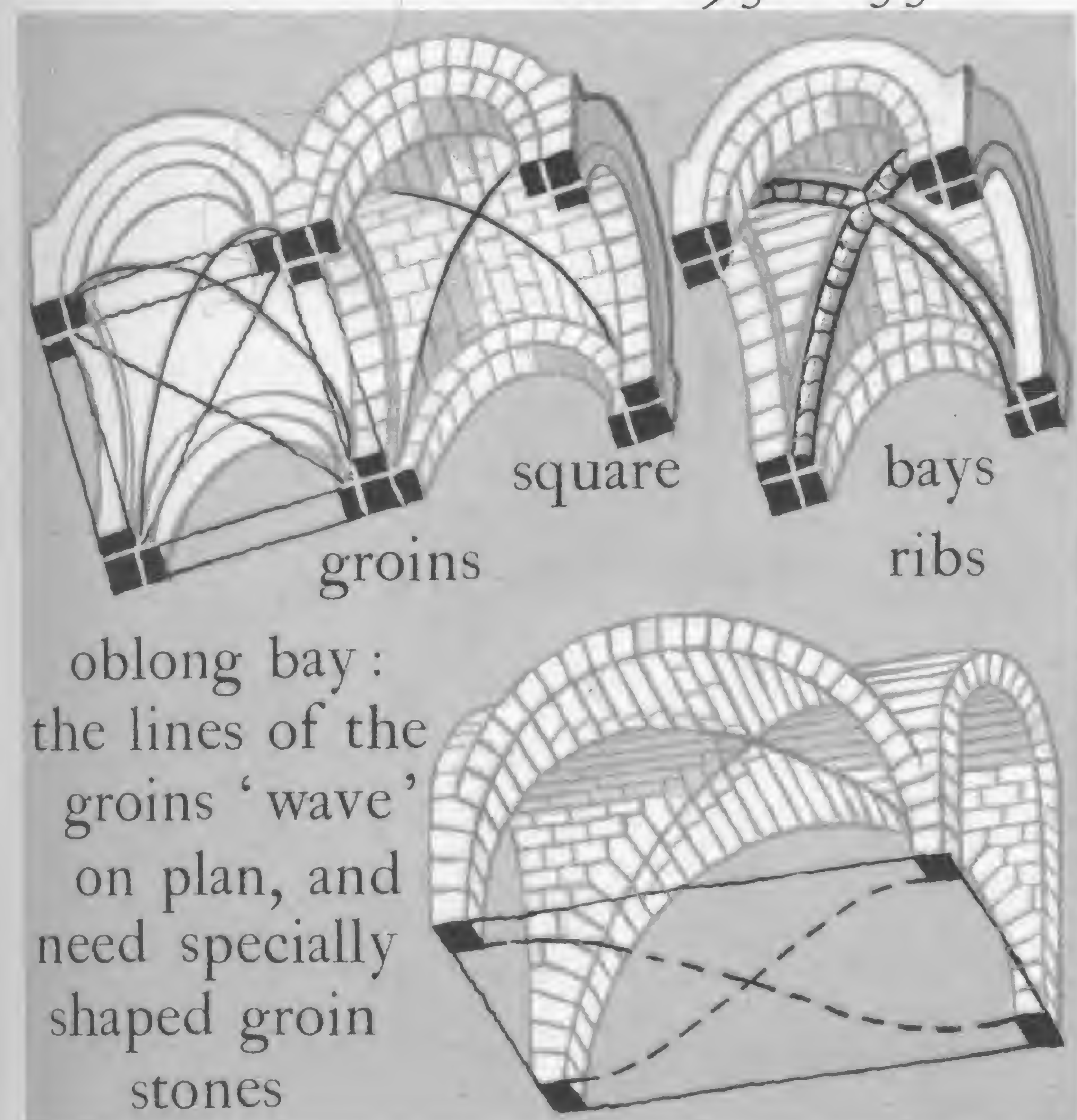
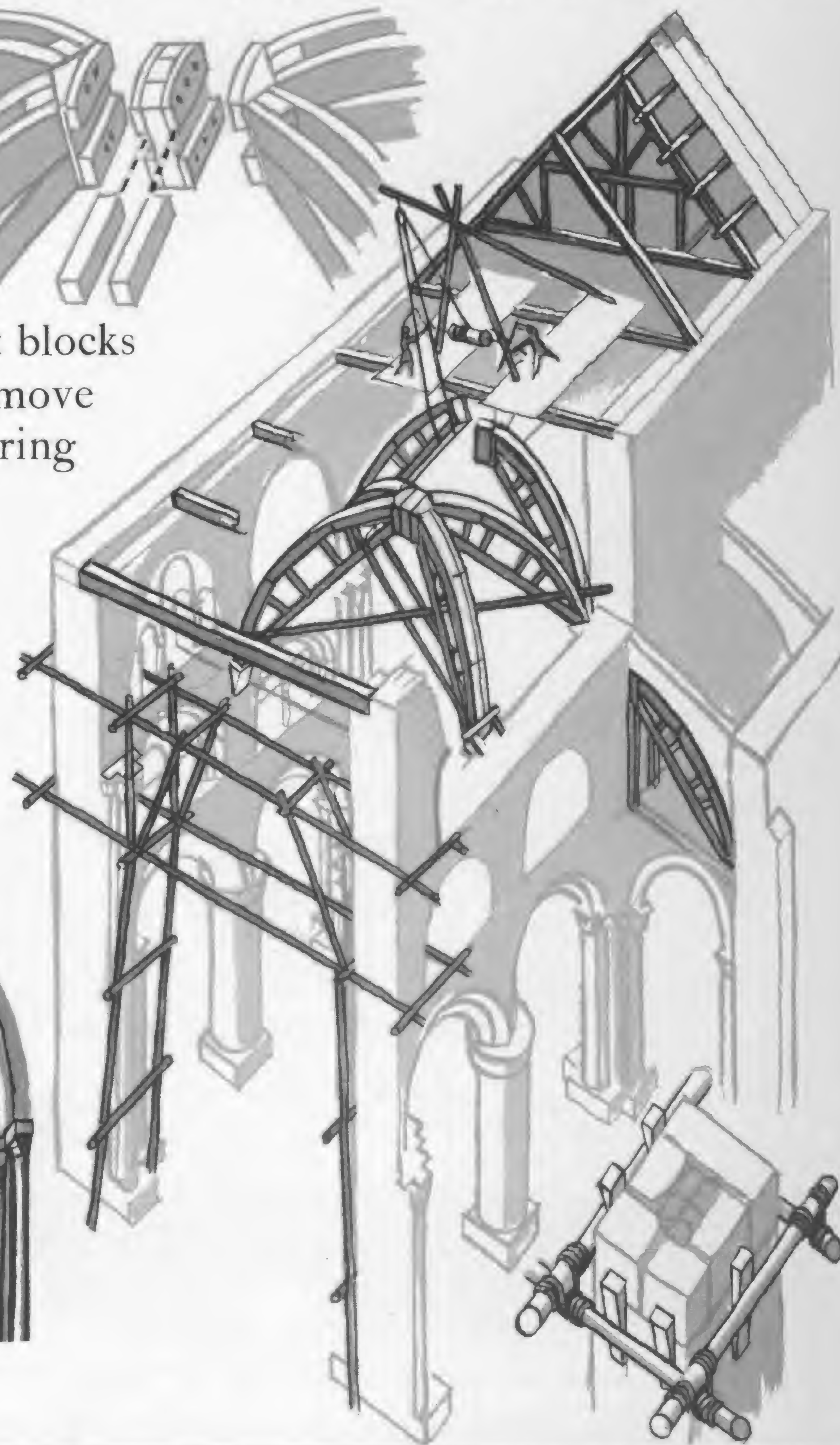
## RIBBED VAULT



Durham Cathedral:  
nave 1093-1133



insert blocks  
to remove  
centering





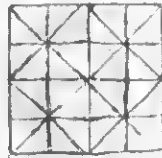
# GOTHIC





# INTRODUCTION

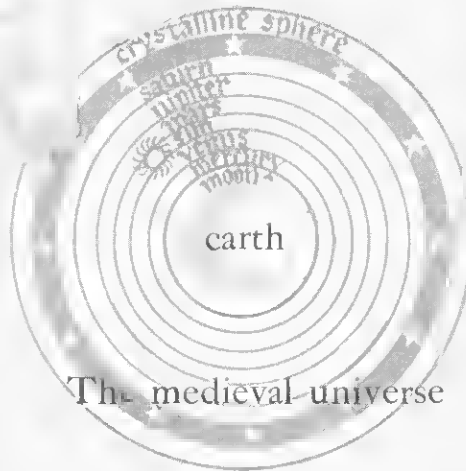
1100	1200	1300	1400	1500	1550
Increase of trade, growth of towns, & rise of guilds	Ascension of Gothic in Ile de France	Black Death 1348-49 1346-The 100 Years' War-1453	1453	End of Eastern Byzantine Empire	
Universities Aristotle (via Arabs)	Scholasticism c.1225-S. Aquinas-c.1275 1265-Dante-1321	Humanism 1304-Petrarch-1374	Italian RENAISSANCE 1452-Leonardo da Vinci-1519		
Discoveries: optical lens, mariner's compass, gunpowder, cannon	1214-Roger Bacon-1294		c.1450 printing		



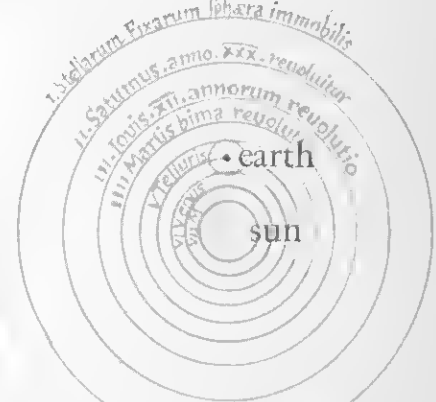
Columbus  
1492

Magellan  
1519-22

Map of the world, 1527



The medieval universe



The universe according to  
1473—Copernicus—1543

The enlargement of S. Denis, 1144 (p.89) inaugurated a lyrical form of construction in which pointed arches, high stone vaults and flying buttresses were fused into an organic whole, and which reached a crescendo in the cathedrals built in the Ile de France (pp.100-101). Gothic, or the 'style Ogivale' (Fr.: pointed) was known as 'Opus Modernum' or 'Opus Francigenum' (French work); the term 'Gothic', i.e. barbarian, was first used by the Humanists of the Renaissance. Few plans survive by the lay master-masons, who designed their buildings with 'a good wit of geometry' and who directed the quarry-men, stone-cutters, smiths, carpenters & workmen. In England (pp.102-105), France (pp.106-107), Italy (pp.108-109) and Germany (pp.110-111) castles, parish churches, guild-halls and houses followed the same pattern of pointed arches, pinnacles, spires & high-pitched roofs. South of the Alps in Italy Gothic was neutralised by the Roman tradition and ceased with the advent of the Renaissance in the 15th century.



# GOTHIC

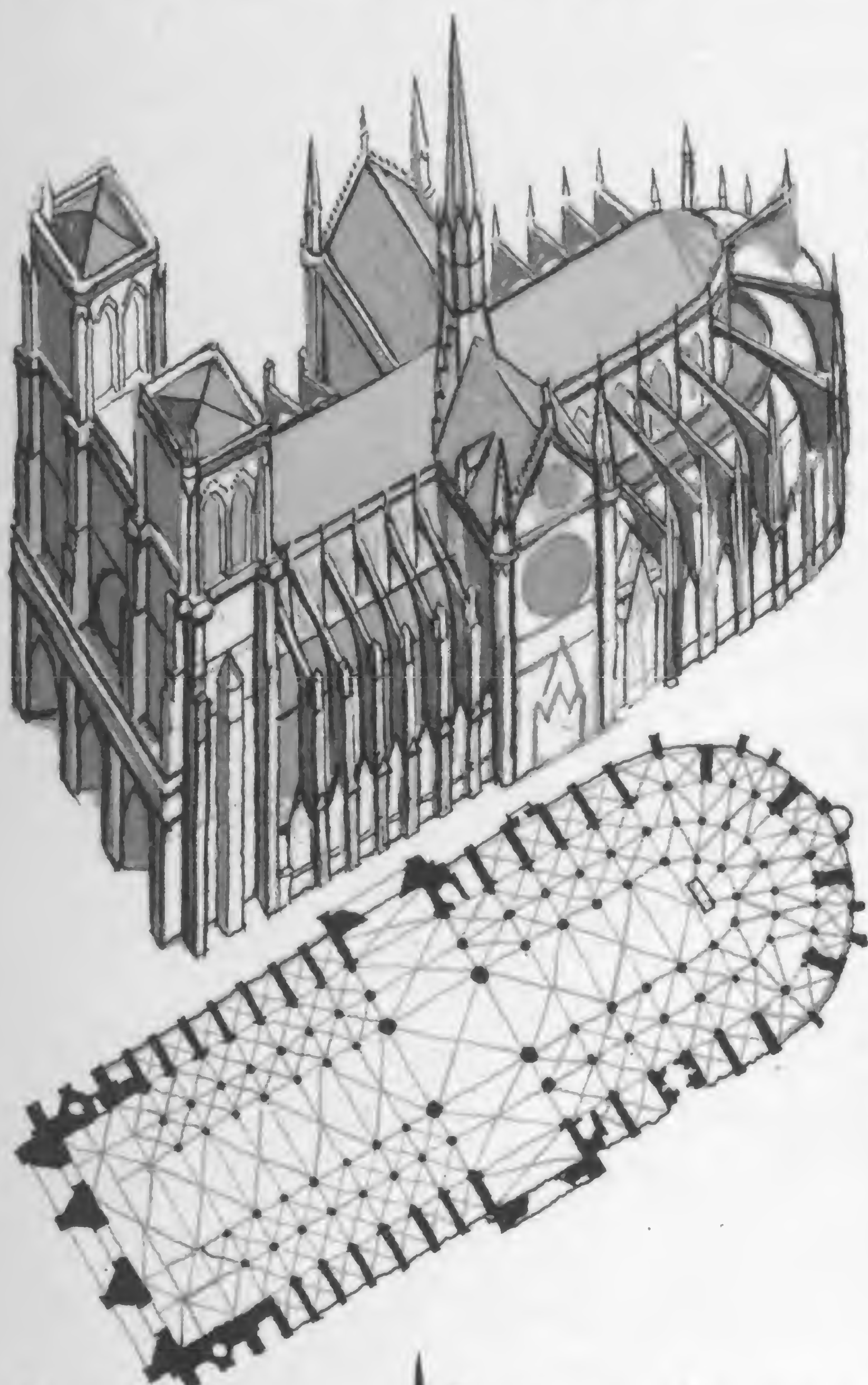
plans  
and elevations  
to the same scale

Amiens Cathedral,

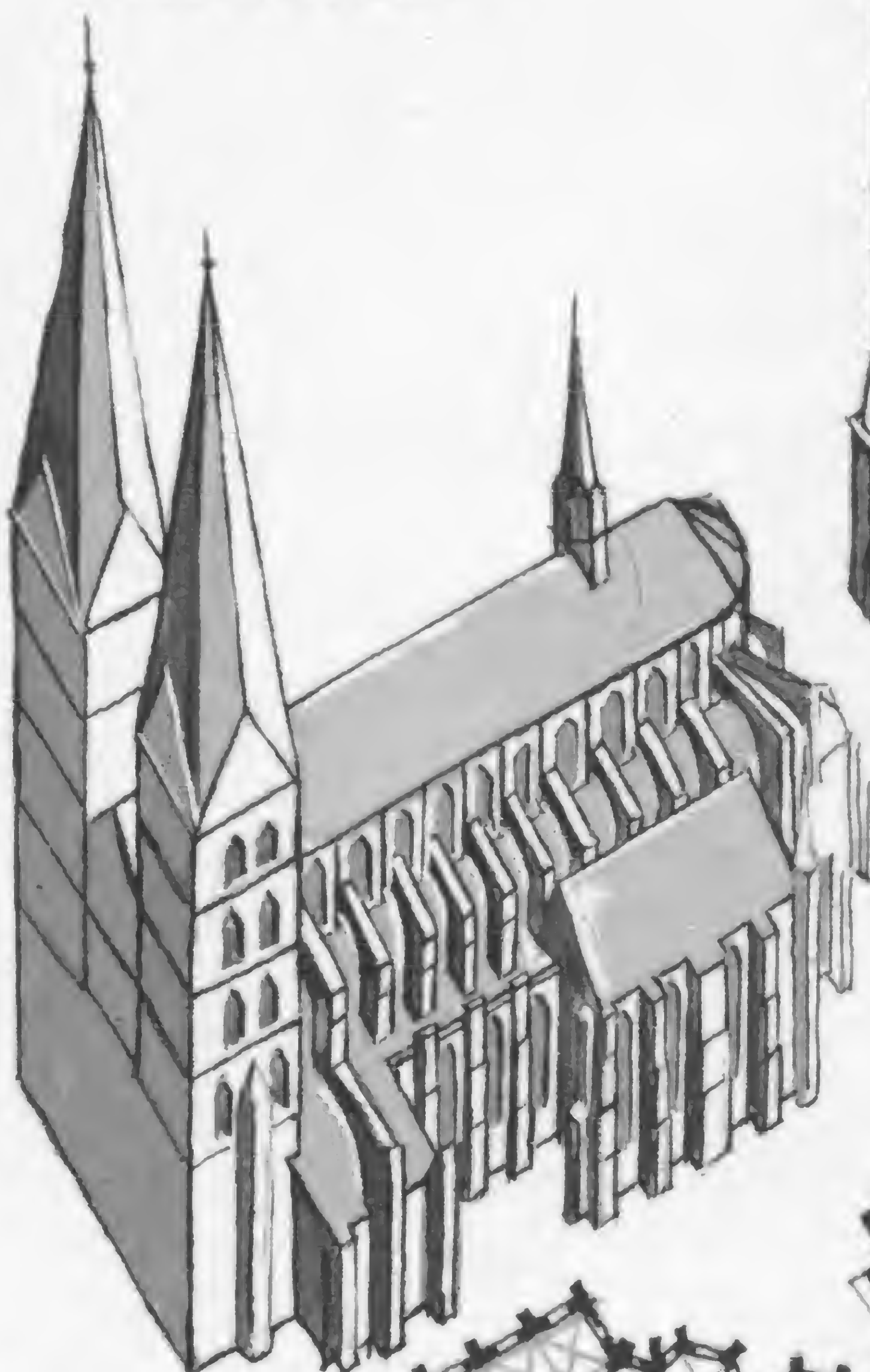
1220-1288

200

FRANCE

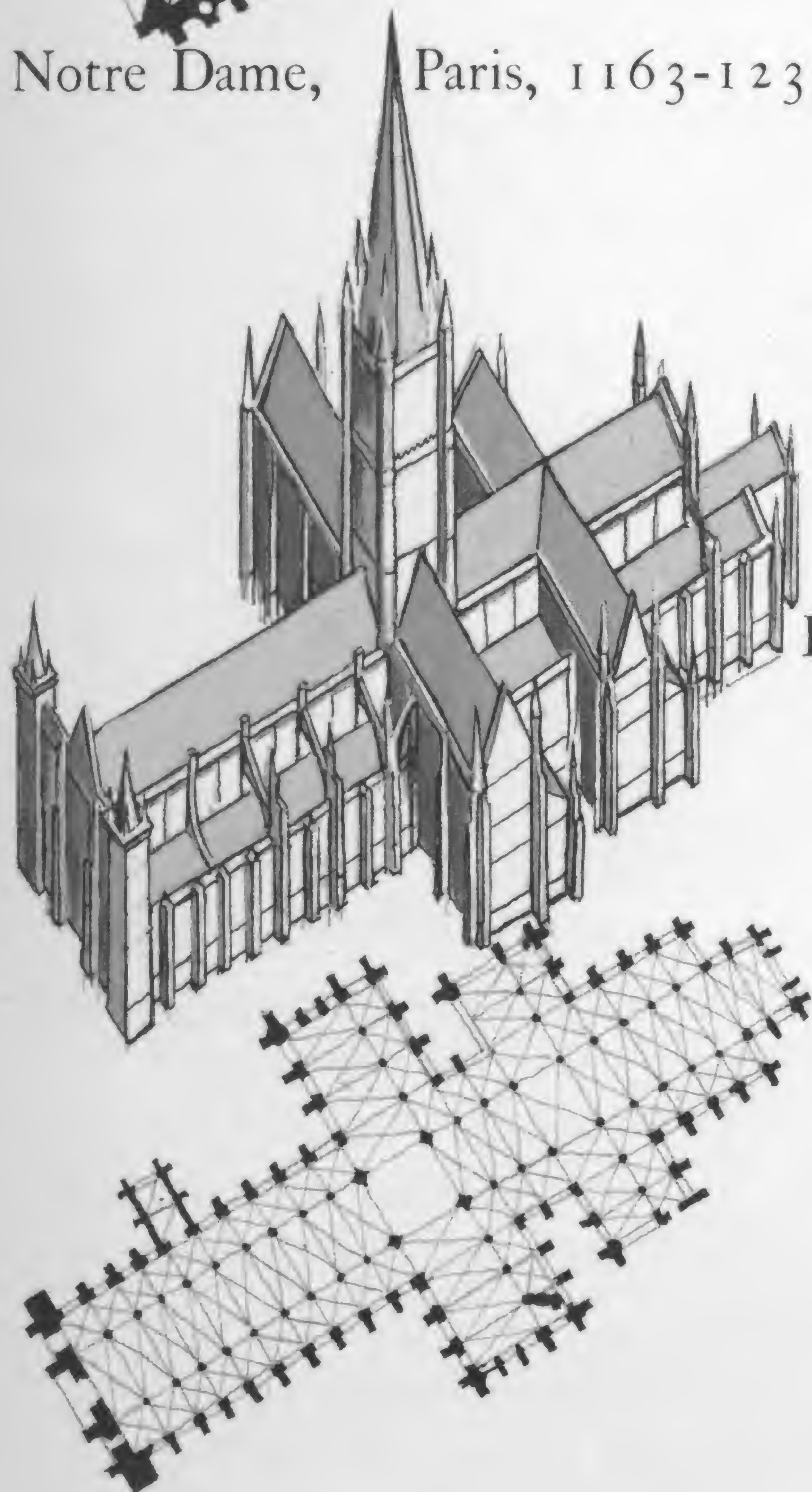
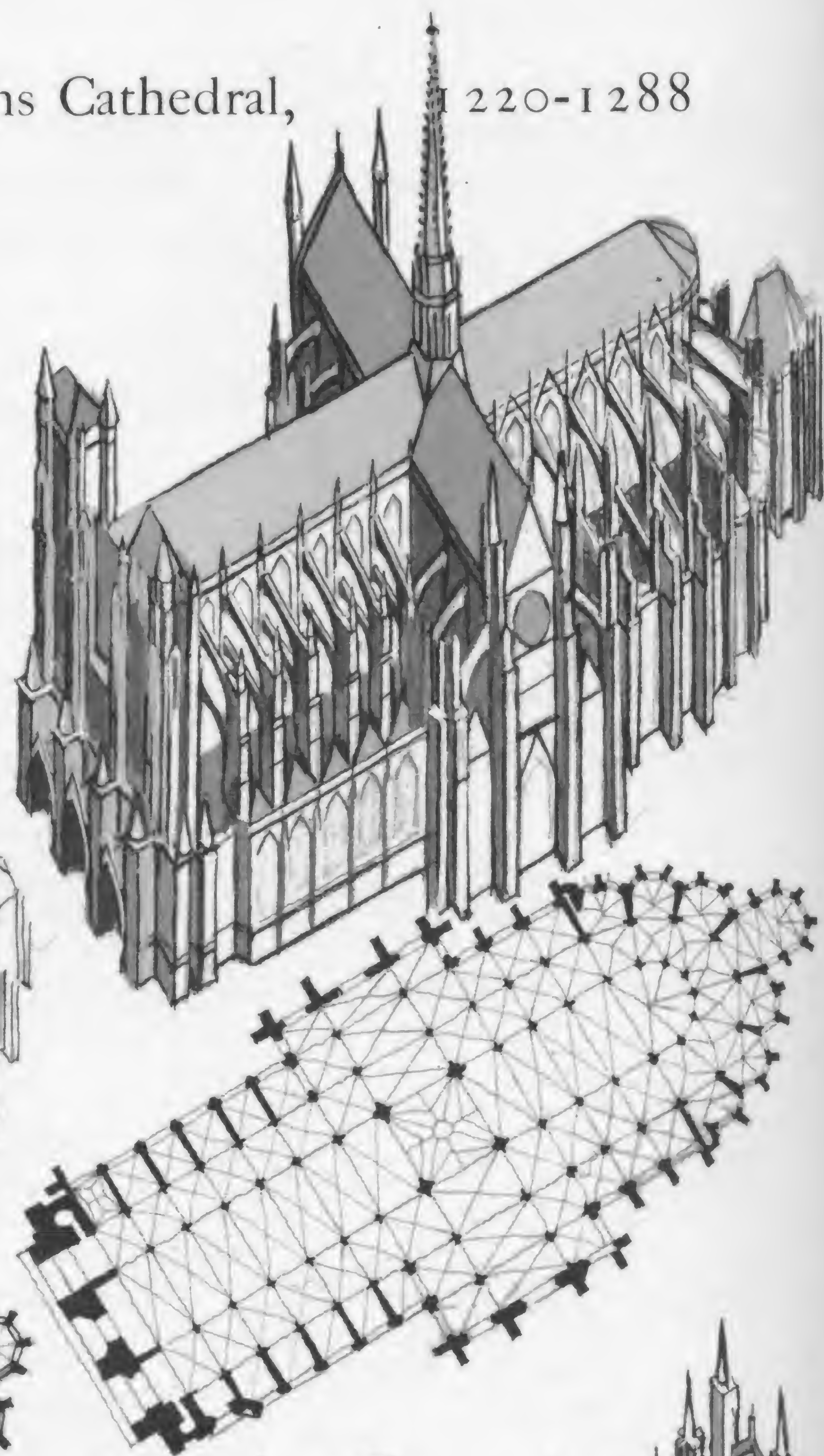


Notre Dame, Paris, 1163-1235



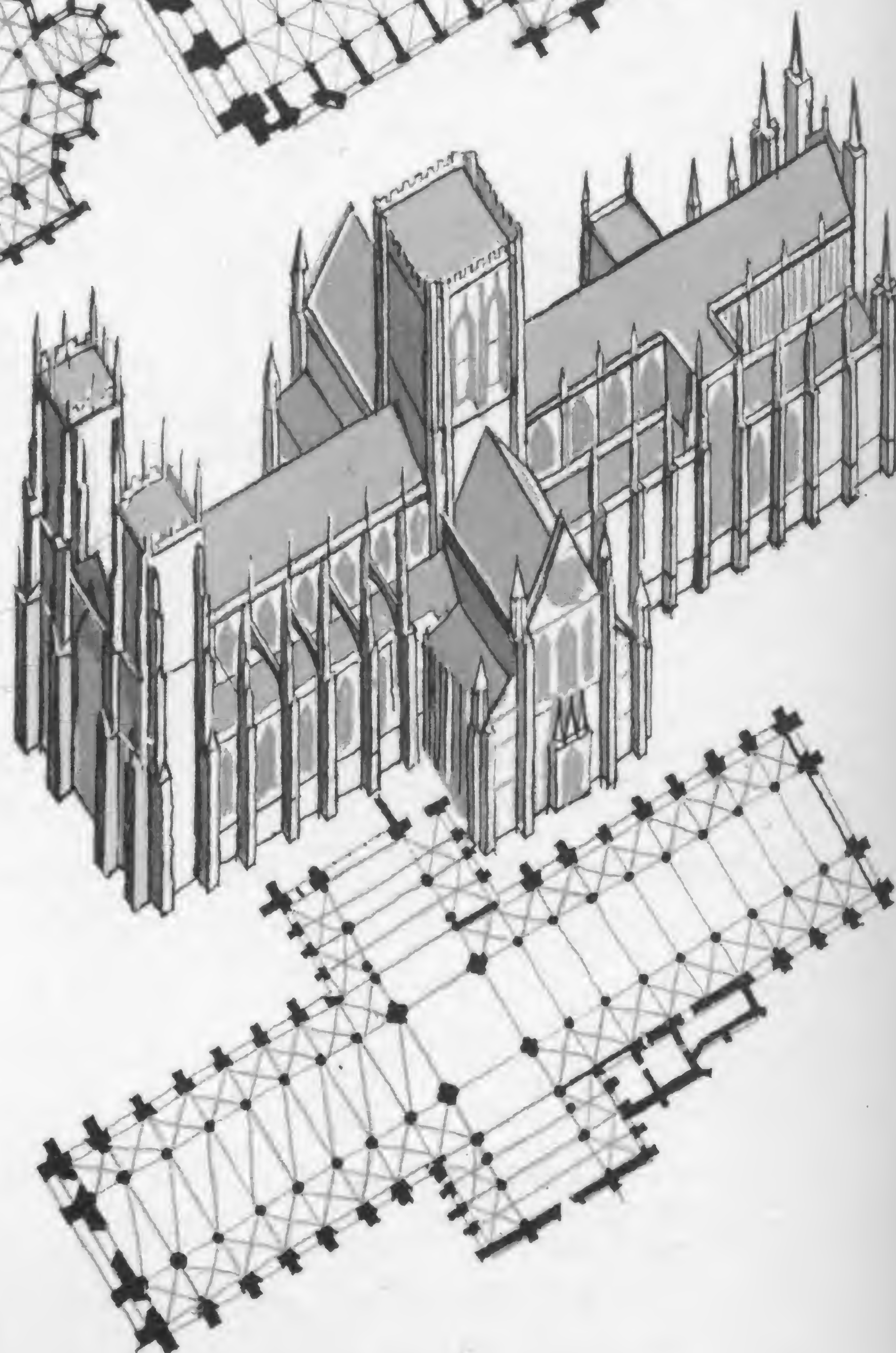
Marienkirche,  
Lübeck, 1251-1310

GERMANY



Salisbury Cathedral, 1220-1258

ENGLAND



York Cathedral, 1261-1324



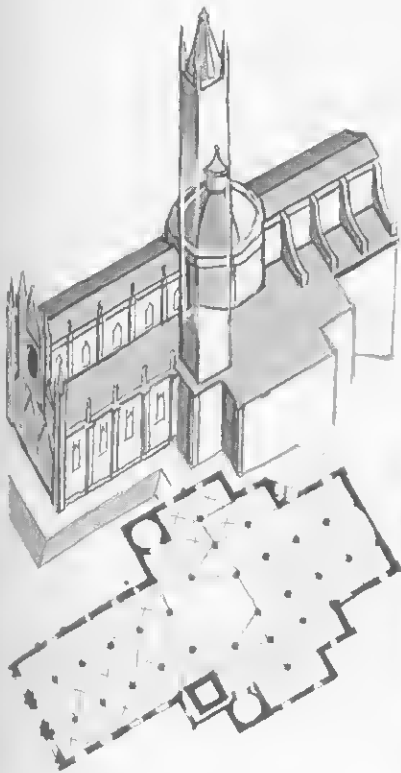
# PLANS & ELEVATIONS

## ITALY

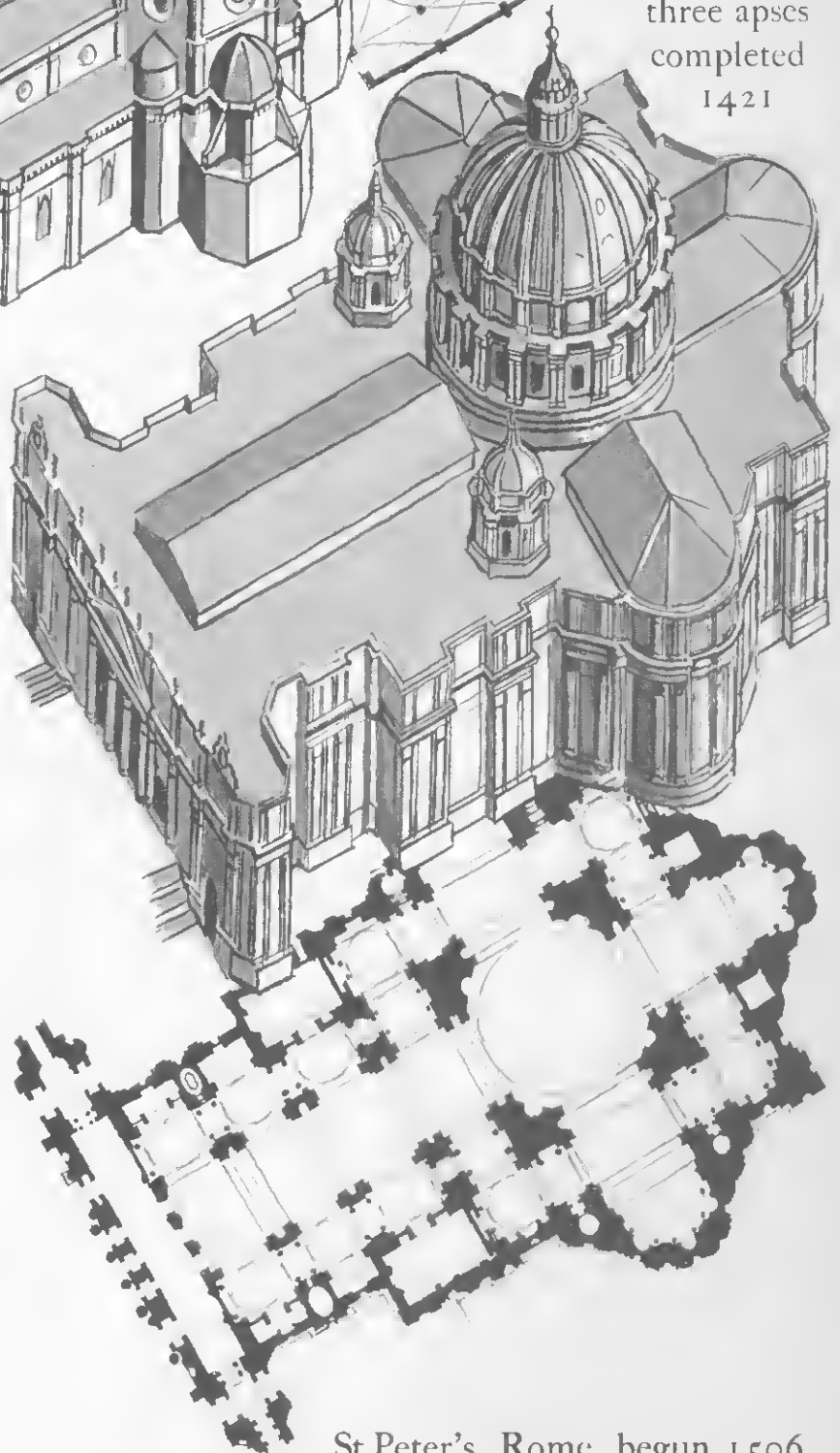
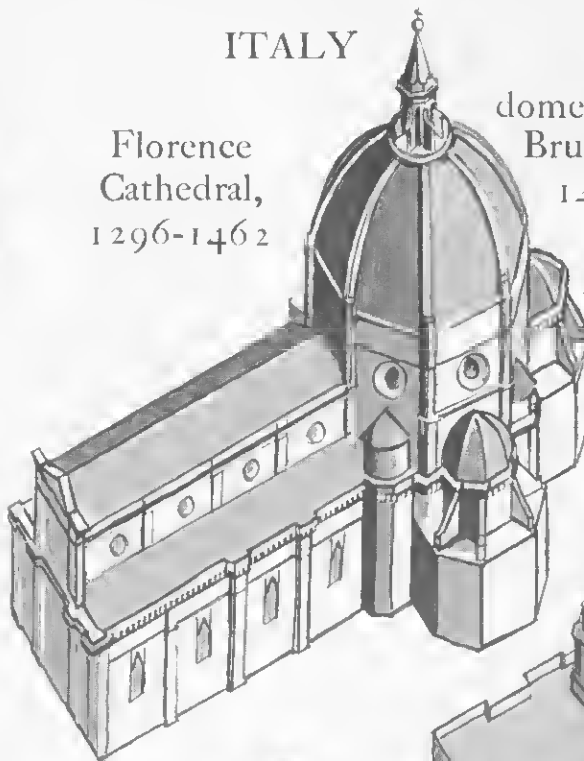
Florence Cathedral,  
1296-1462

dome added by  
Brunelleschi  
1420-37

three apses  
completed  
1421



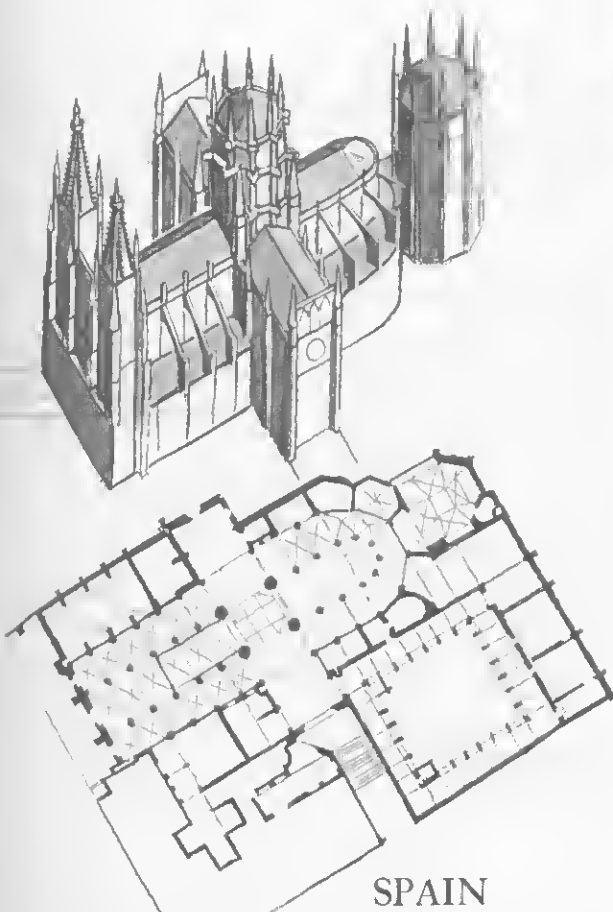
Siena Cathedral,  
1245-1380



St Peter's, Rome, begun 1506

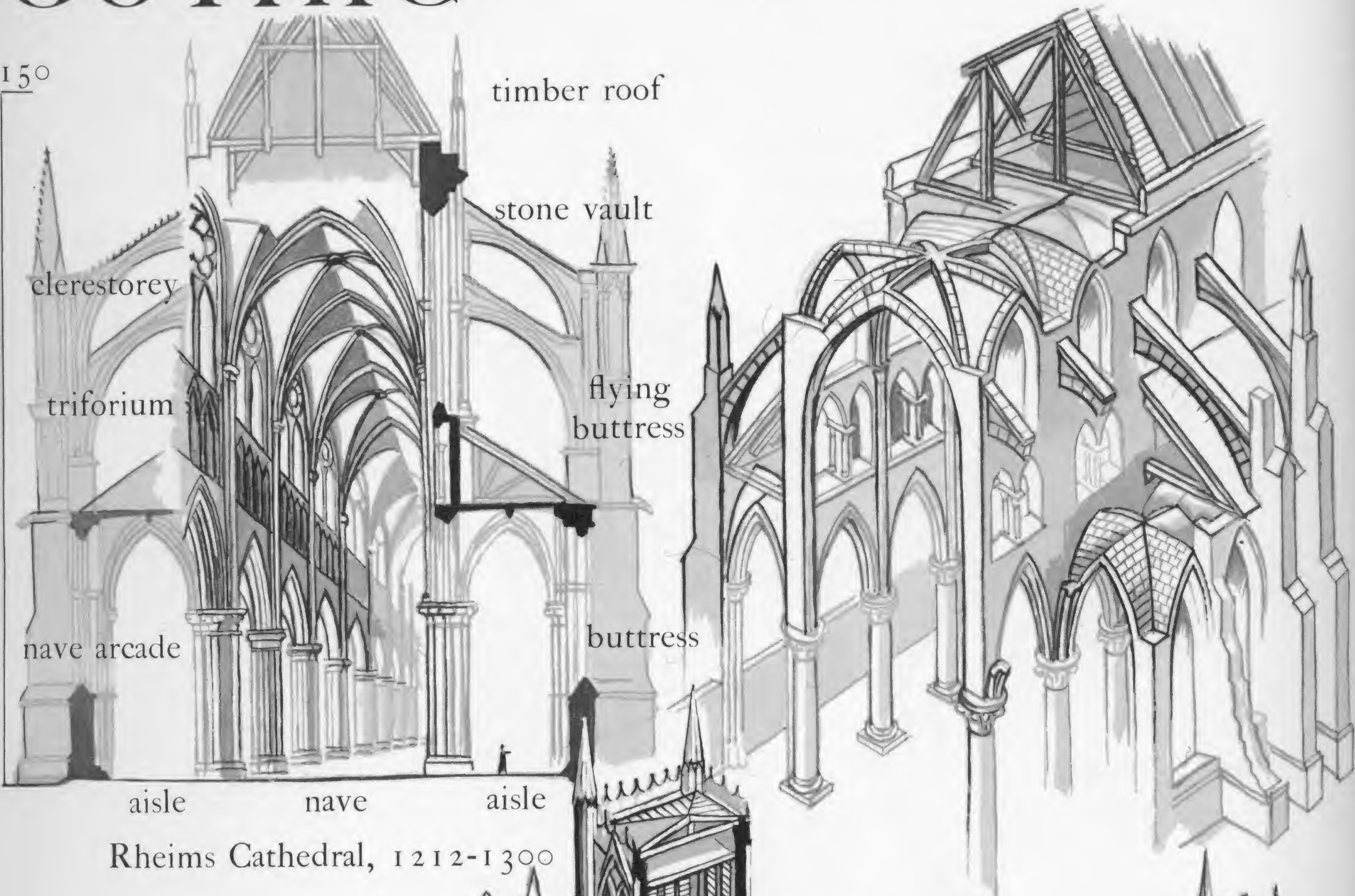
## SPAIN

Burgos Cathedral, 1220-1500

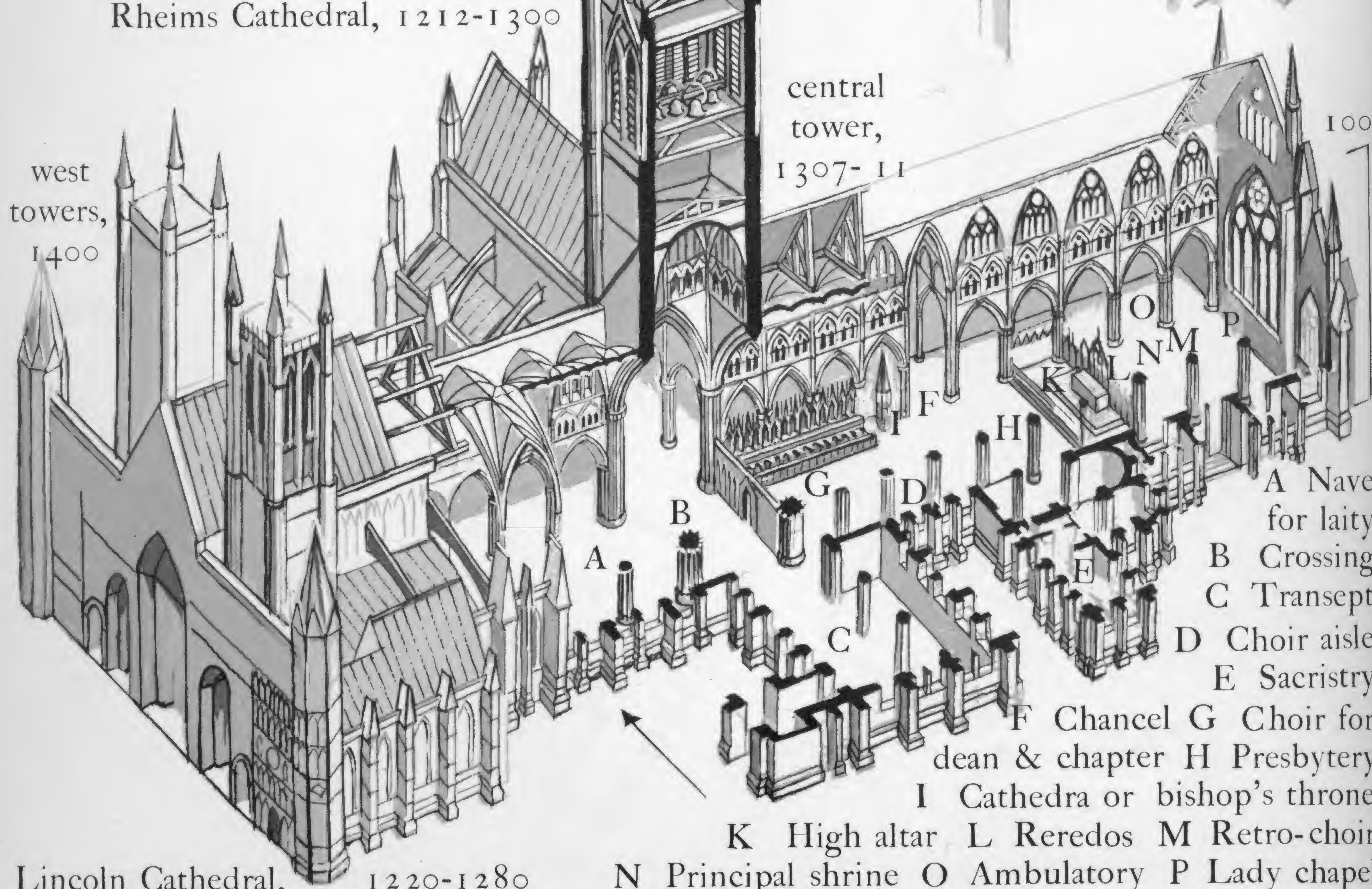




# GOTHIC



Rheims Cathedral, 1212-1300



Lincoln Cathedral, 1220-1280

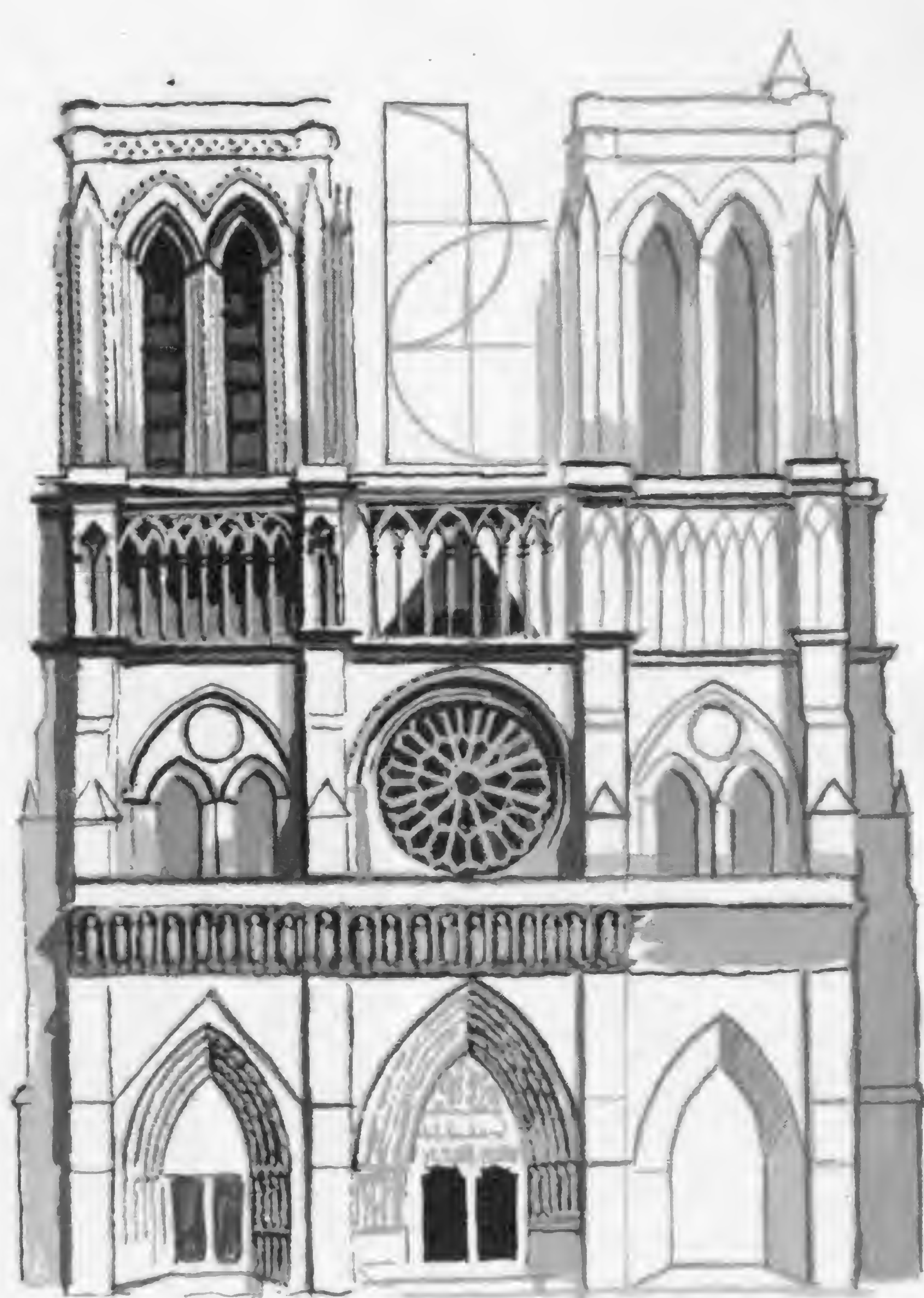
- A Nave for laity
- B Crossing
- C Transept
- D Choir aisle
- E Sacristy
- F Chancel
- G Choir for dean & chapter
- H Presbytery
- I Cathedra or bishop's throne
- K High altar
- L Reredos
- M Retro-choir
- N Principal shrine
- O Ambulatory
- P Lady chapel



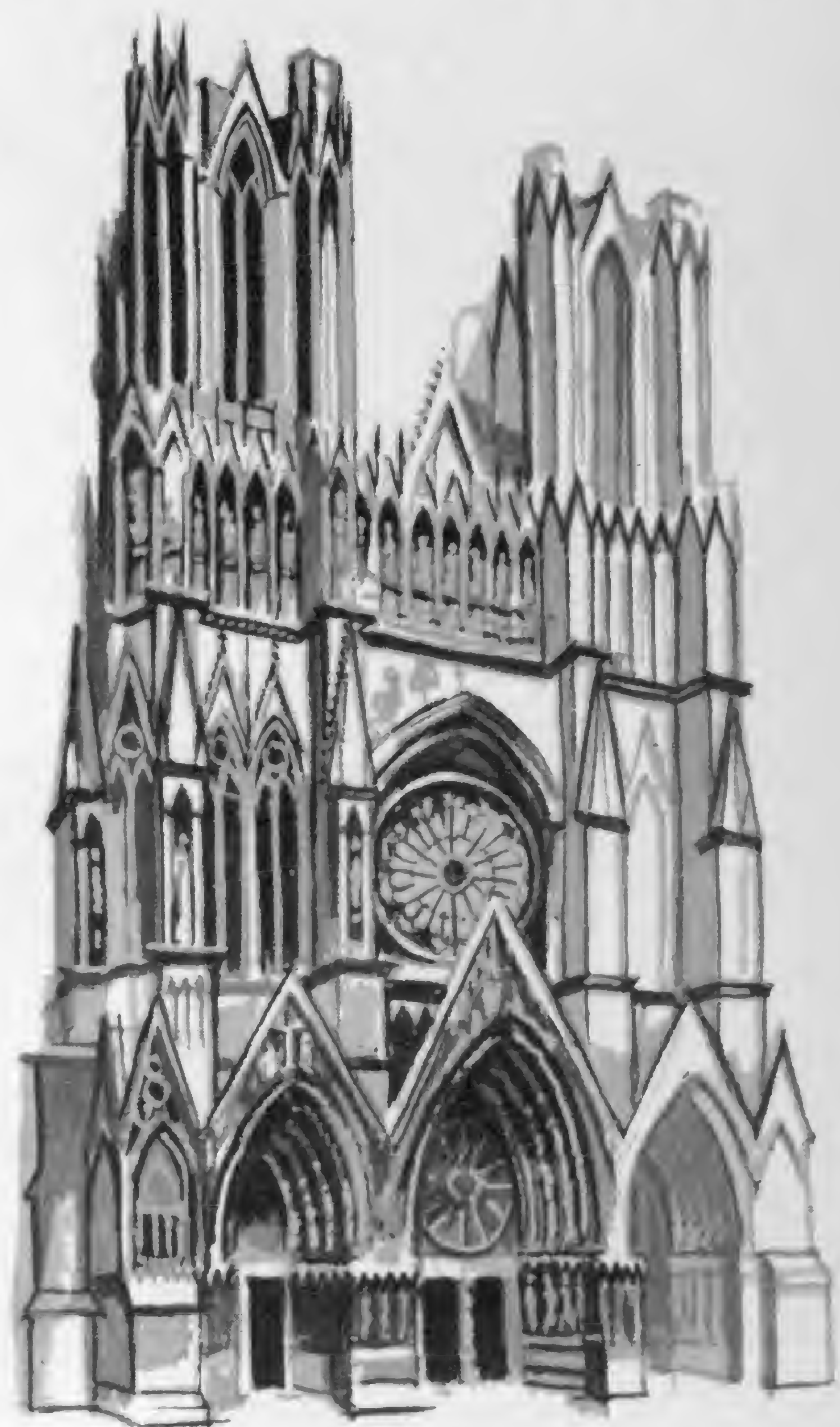
# THE PARTS OF A CATHEDRAL



Laon Cathedral,  
c. 1235



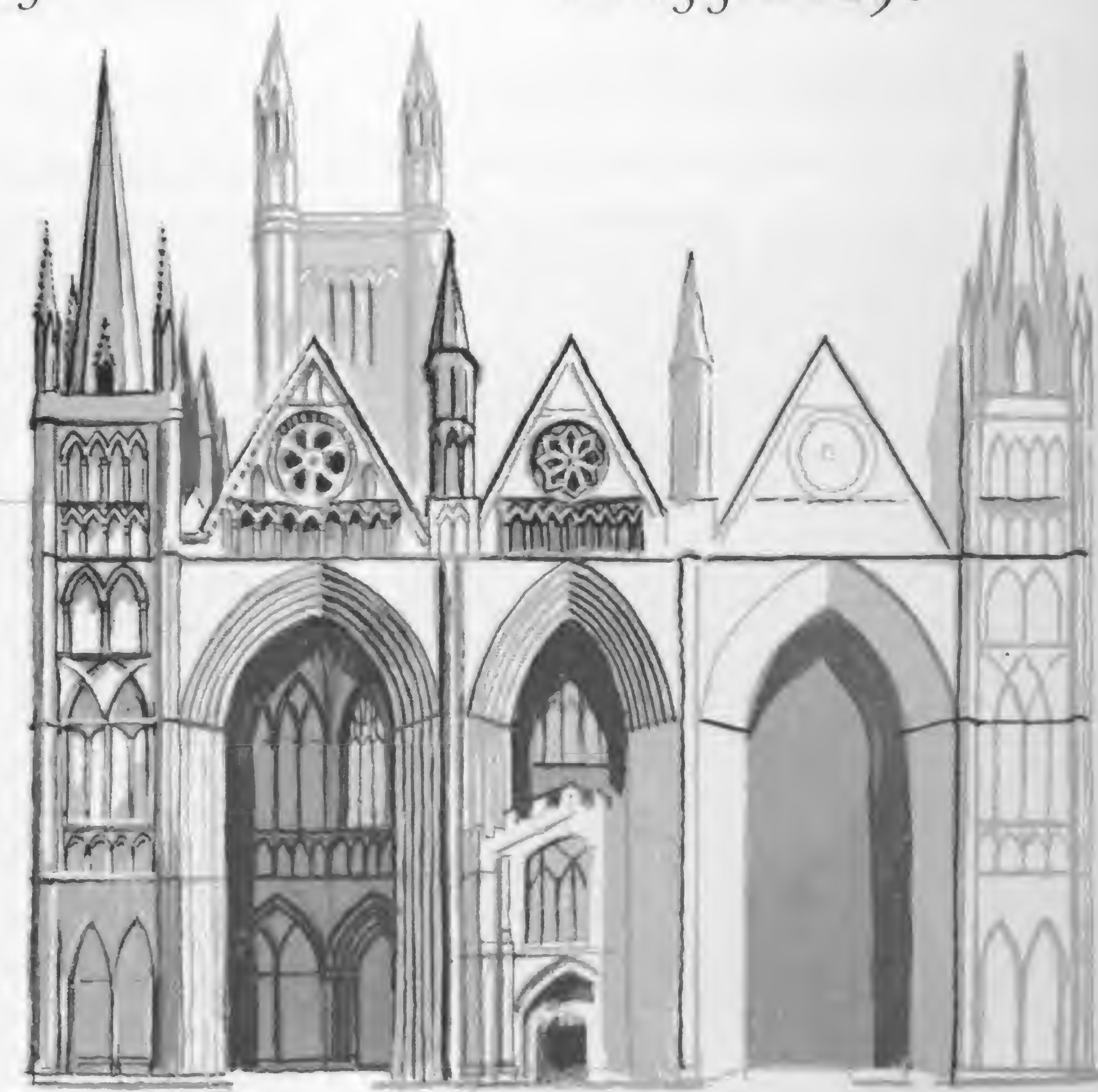
Notre Dame, Paris,  
c. 1200-1250



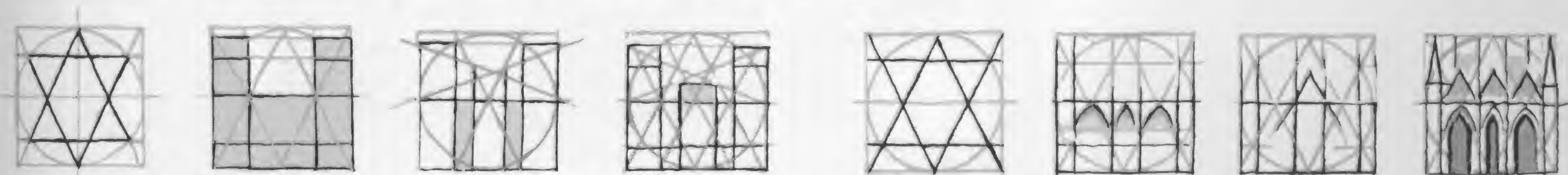
Rheims Cathedral,  
c. 1255-c. 1290



Wells Cathedral, c. 1220-1242



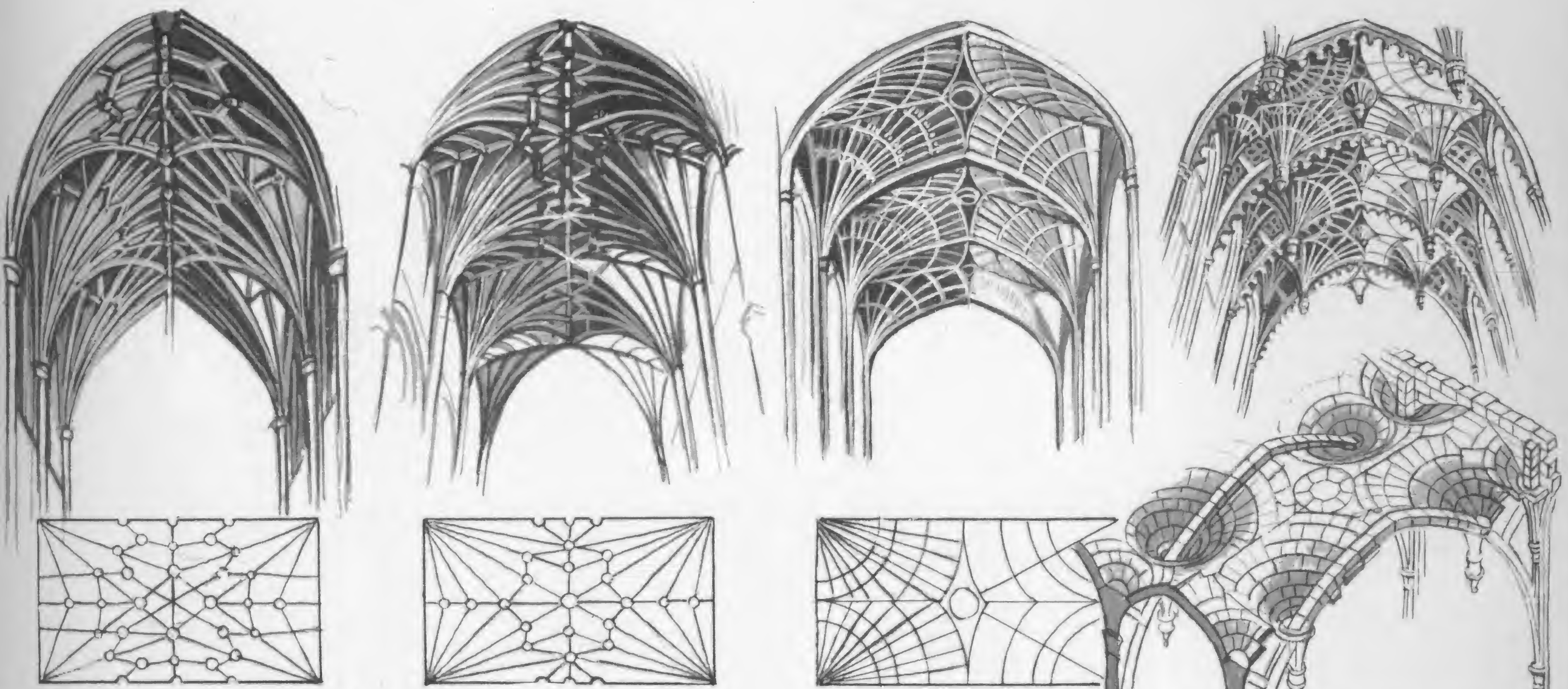
Peterborough Cathedral, c. 1235



THE WEST FRONT



# ENGLAND, STONE VAULTING



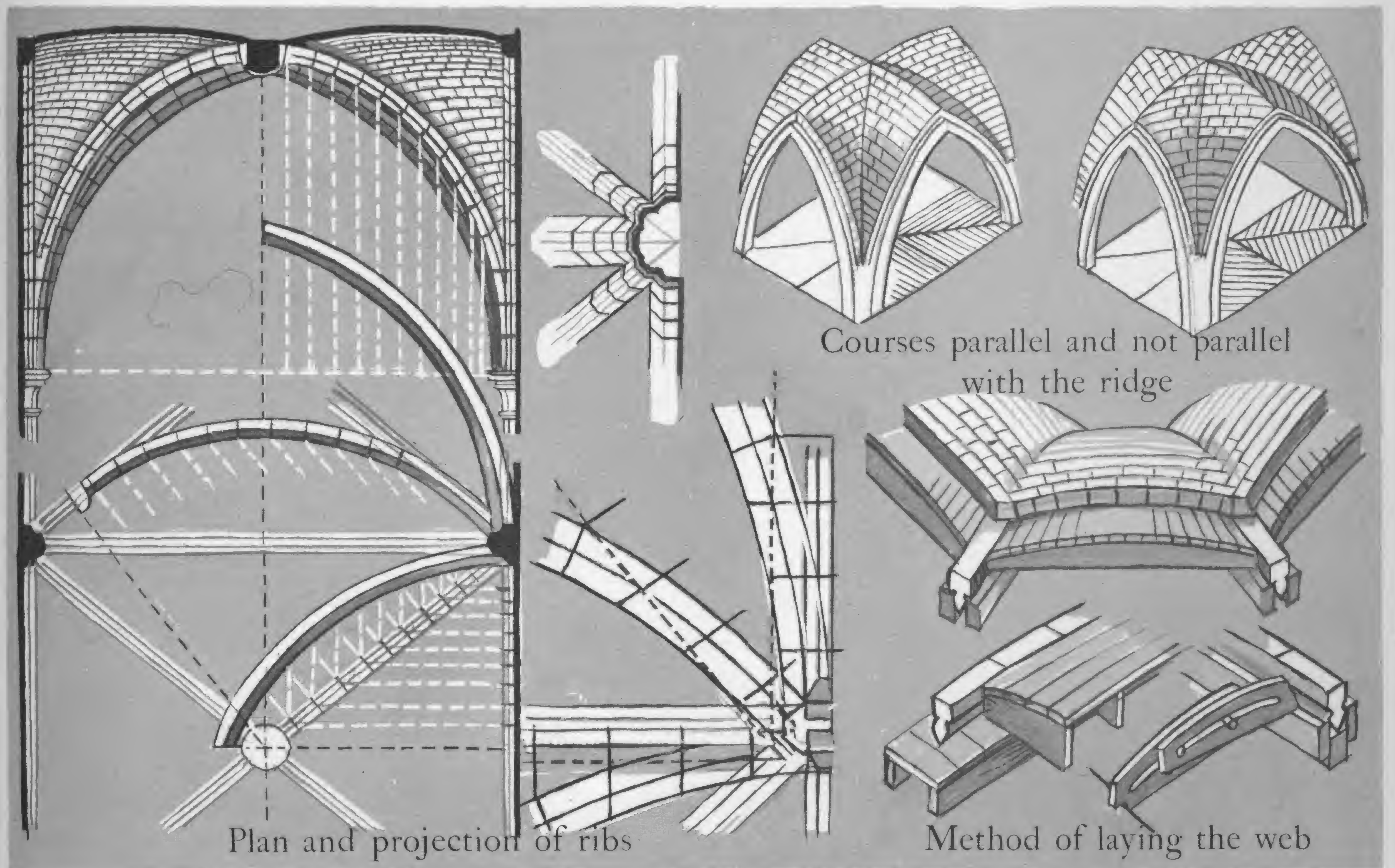
Introduction of liernes or small ribs  
with shorter web courses

Winchester  
Cathedral nave,  
1371-1460

Norwich  
Cathedral nave,  
1463-1472

Fan vaults: all ribs of equal span  
and the web carved from the same stone  
King's College Chapel, Cambridge,  
1446-1515

Henry VII's Chapel,  
Westminster Abbey,  
1502-1512



Plan and projection of ribs

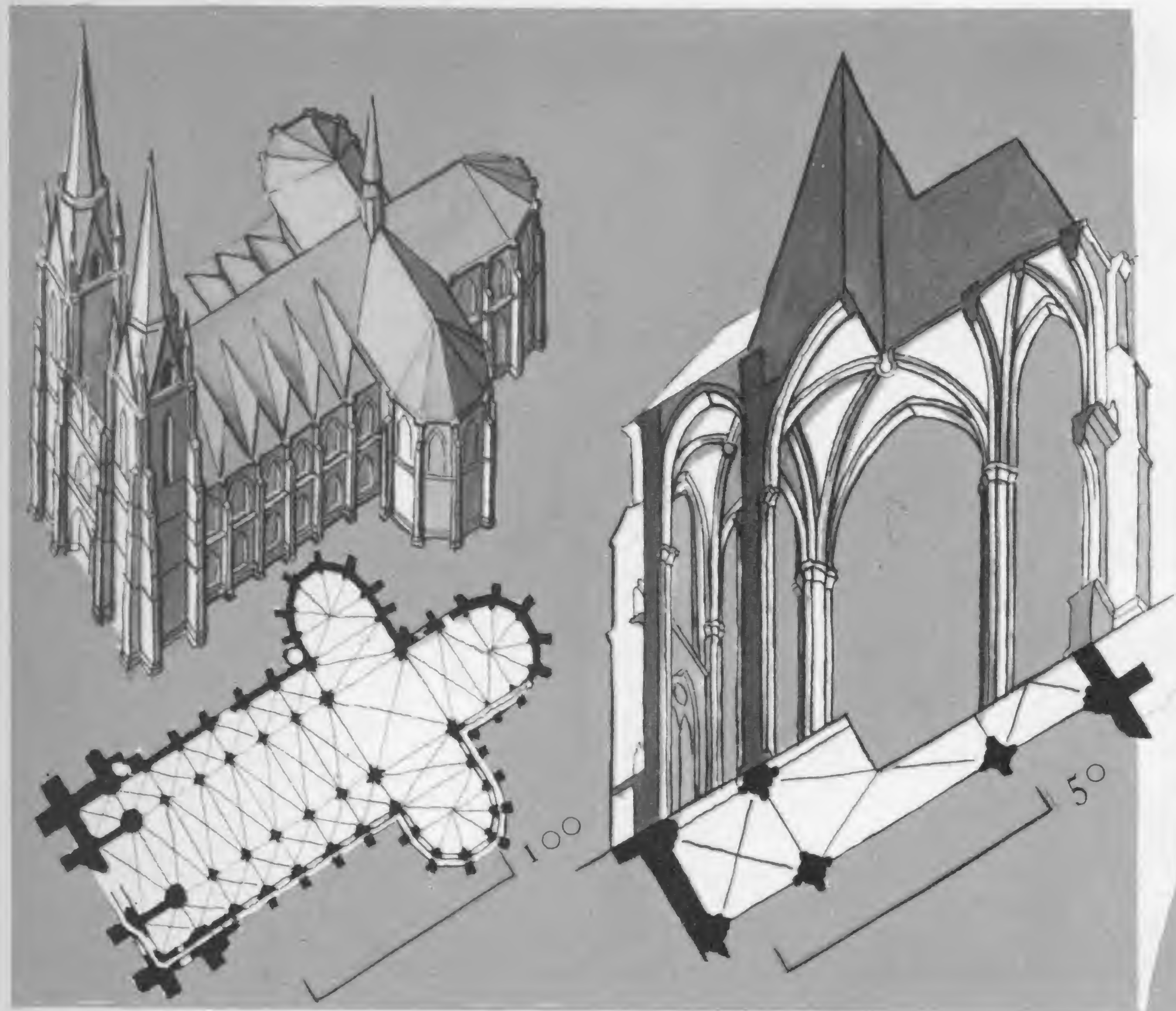
Courses parallel and not parallel  
with the ridge

Method of laying the web

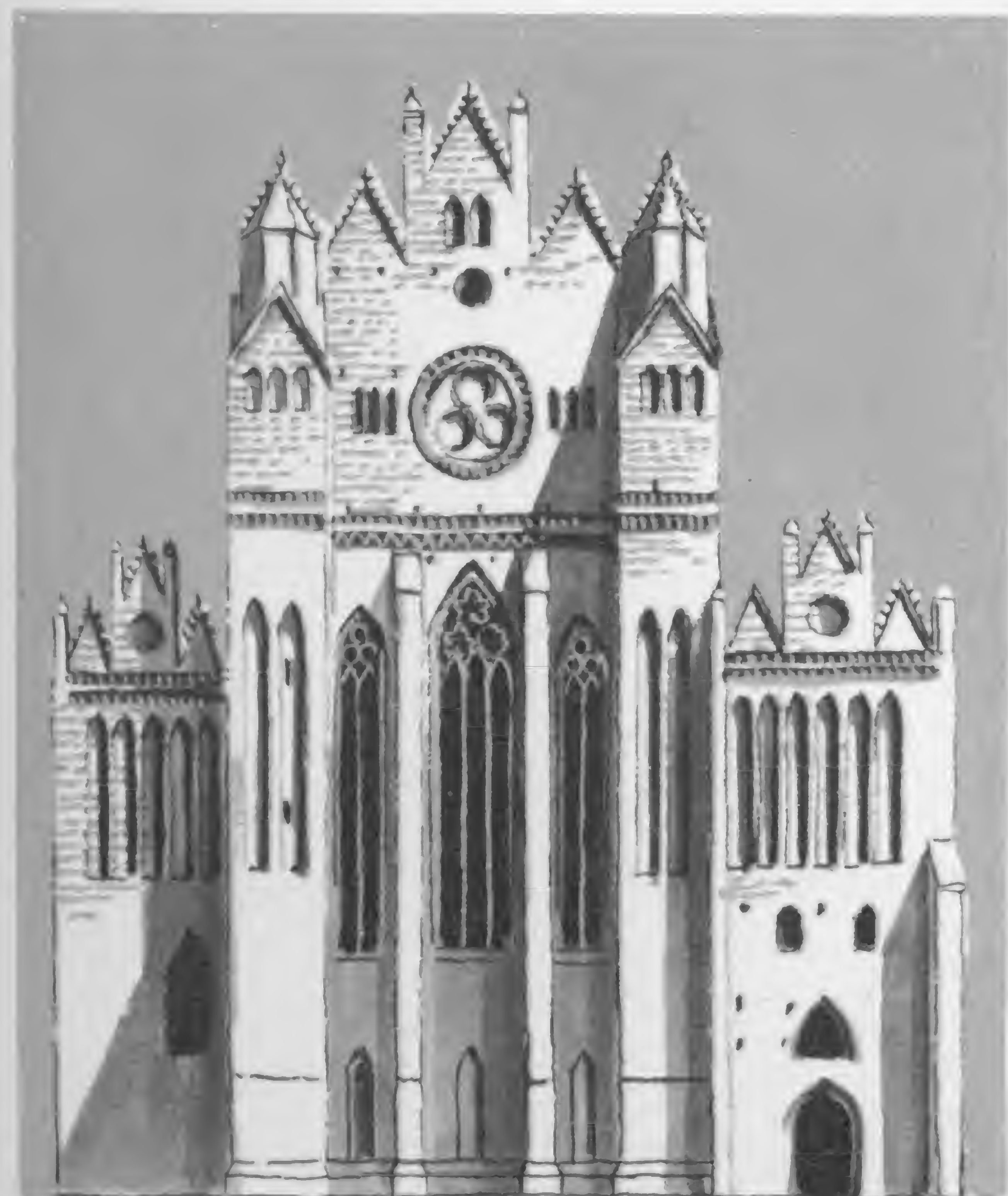


# GOTHIC

385



S. Elizabeth, Marburg, c.1233-1283:  
one of the many 'Hall' churches in North Germany,  
having the nave and aisles of equal height



Chorin Abbey, c.1273-1334:  
west front



Freiburg Cathedral, c.1268-1288:  
west front



# RENAISSANCE BAROQUE

1400  
The Turks take Constantinople

1453  
& block trade with the Orient:  
this leads to maritime discoveries

1500

1600

The Empire of \_\_\_\_\_ and his son

Spain      Spain united 1497   1519—Charles V—1556—Philip II of Spain—1598

Italy   Florence: the Renaissance   Rome: temporal power of the Popes   Venice: trade lost

France   Franco-Spanish rivalry in Italy   1515—Francis I—1547   Italian influence

Holland      1568 Revolt of the

England      1485—Henry VII—1509—Henry VIII—1547—1558—Elizabeth I—1603

War of the Roses   Italian influence   Mary I marries Philip II of Spain

1483 • Invention of printing

1480 • Mainz, c. 1450 brought the revival and spread of Latin and Greek texts

1470 •

1469 •

1467 •

1466 •

1459 •

1483—Martin Luther—1546

Protests (hence Protestants) against the Roman Church leads to the Reformation

Protestant

Catholic

Greek

Moslem

the Counter-Reformation

Trent

Rome

Internal Reformation of the Roman Church at the Council of Trent 1545-63, aided by

1499—S. Ignatius Loyola—1556 founded the Society of Jesus

empyrean

planets

earth

The Medieval universe, haunted by the law and order of the Roman Empire

earth

sun

Concerning the Revolutions of the Heavenly Spheres

Nuremberg, 1543

1473—Copernicus—1547

On the Infinite Universe & its Worlds

1584

1564—Bruno—1600

## THE RENAISSANCE

The Renaissance (Florence)

1400

Renaissance churches were centralized and designed on the drawing-board. They were inspired by classical architecture, as interpreted by Vitruvius (above all, by Roman temples, arches, domes & the Five Orders (pp. 116-117)), & obeyed the canon

1500

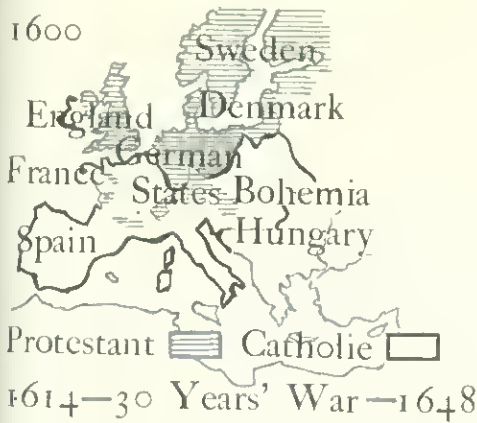
High Renaissance (Rome)   Mannerism

of the Divine Proportions (pp. 118-119). The increasingly dramatic movements of High Renaissance and Mannerist buildings became, especially in the 'theatrical' churches of the Counter-Reformation, an interplay of forces. (This required the drawing of

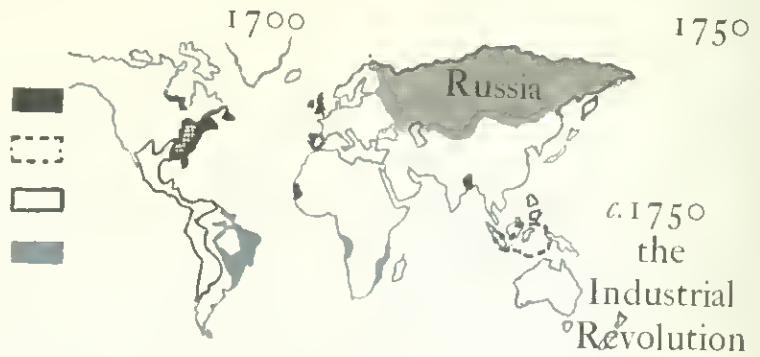
1600



# INTRODUCTION



English  
Dutch  
Spanish  
Portuguese



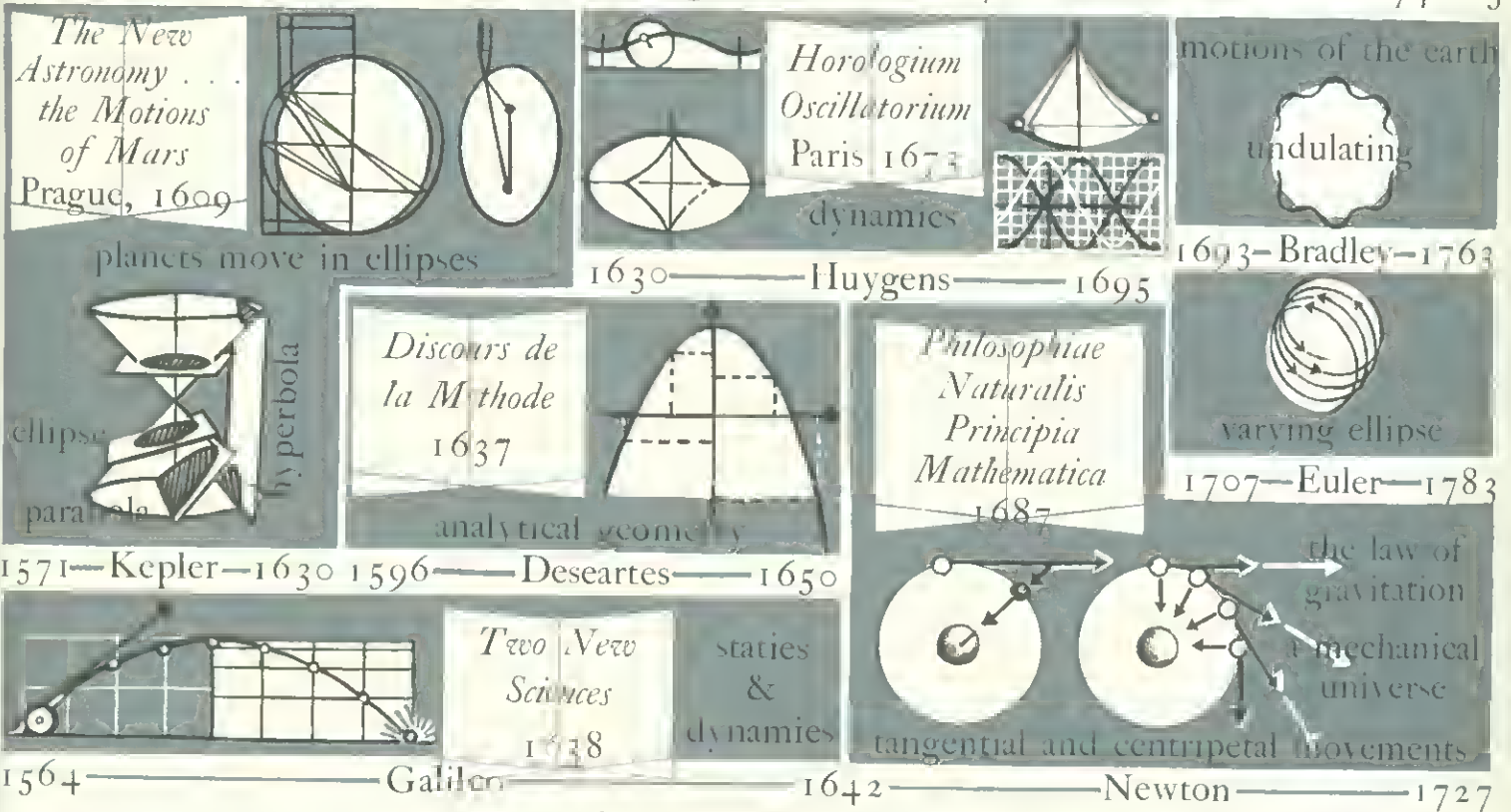
Conflict for colonies and overseas trade

to new Atlantic seaports. Domination of Spain in Italy ends 1710

1610-Age of the Cardinals-1643-Ascension of France: Louis XIV-1715-Louis XV-1774  
Netherlands from Spain 1648 Republic of the United Provinces

James I-1625-Charles I-1649-1660-Charles II-1685-1689 1702-Anne-14-George I-1727  
Divine Right of Kings Commonwealth James II Colonial Expansion

Impoverished by the 30 Years' War Kingdom of Prussia 1701 Frederik the Great 1740-85



## THE BAROQUE

Baroque

Rococo

1600

three-dimensional elevations and curved details by means of projective geometry, which had been developed by the new science of dynamics.)

This Baroque style was finally resolved into the lighter curves of the Rococo.

1700 1750

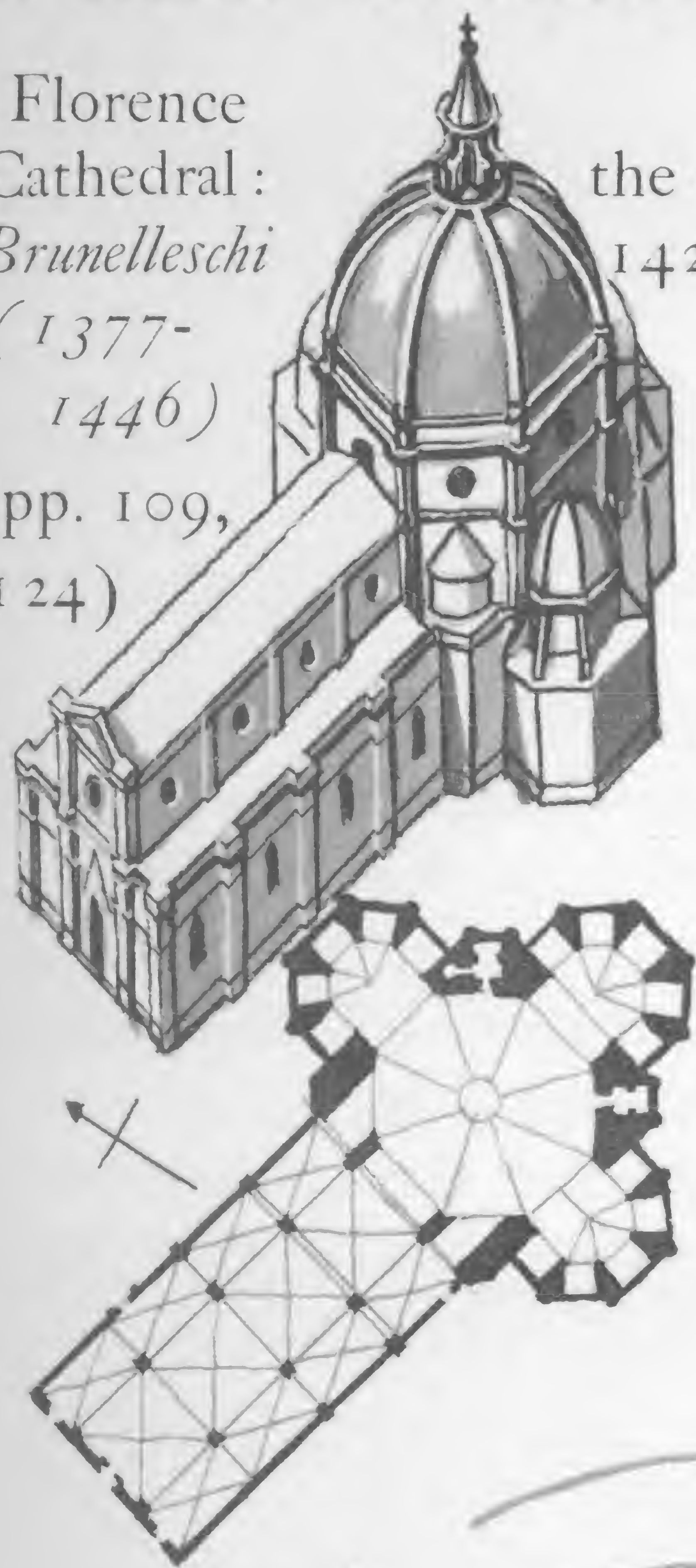
The architecture of each European country was a reaction to that of Italy, modified by its own native characteristics.

France (pp. 130-133), Germany & Austria (pp. 134-135), Spain (pp. 136-137), England (pp. 138-159).

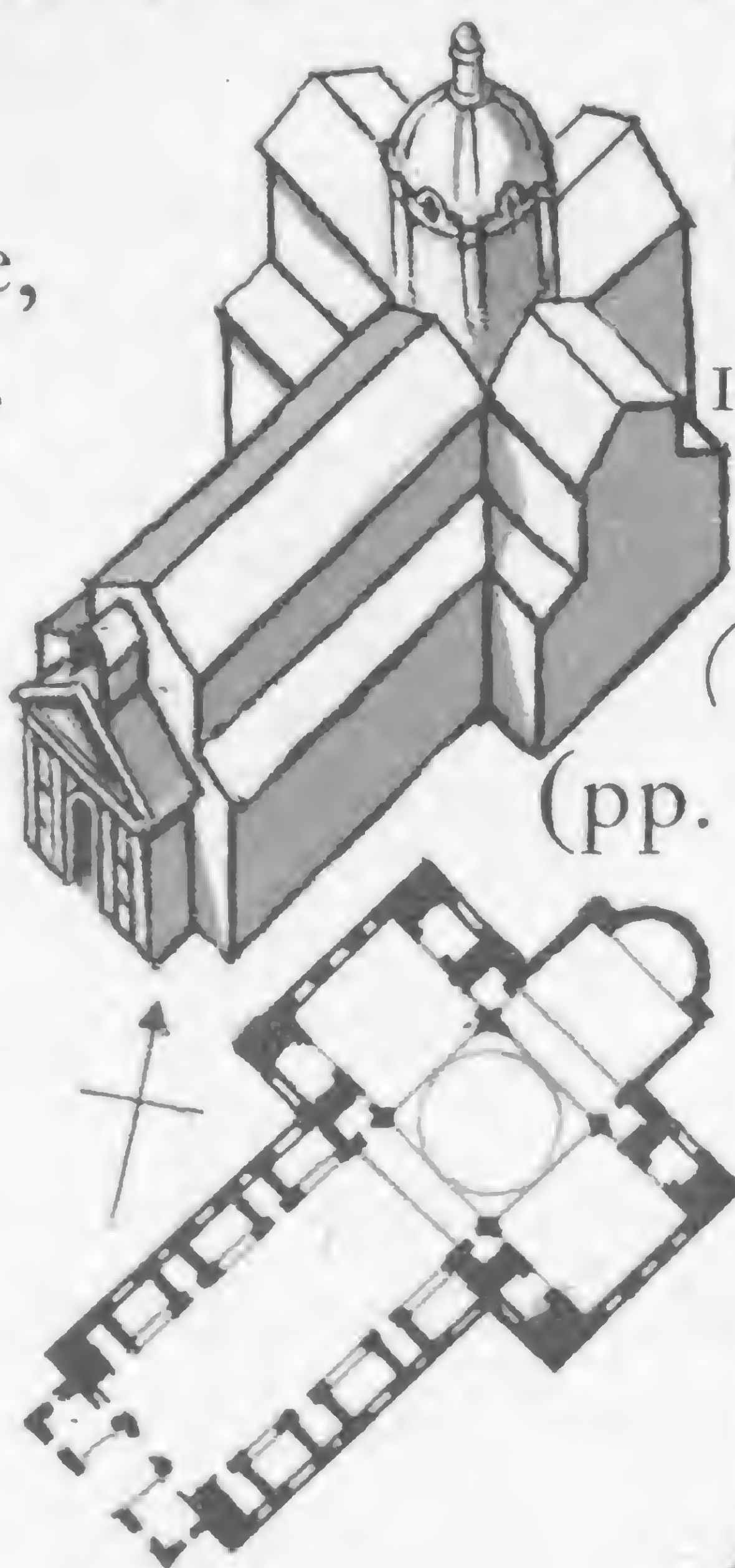


# RENAISSANCE - BAROQUE

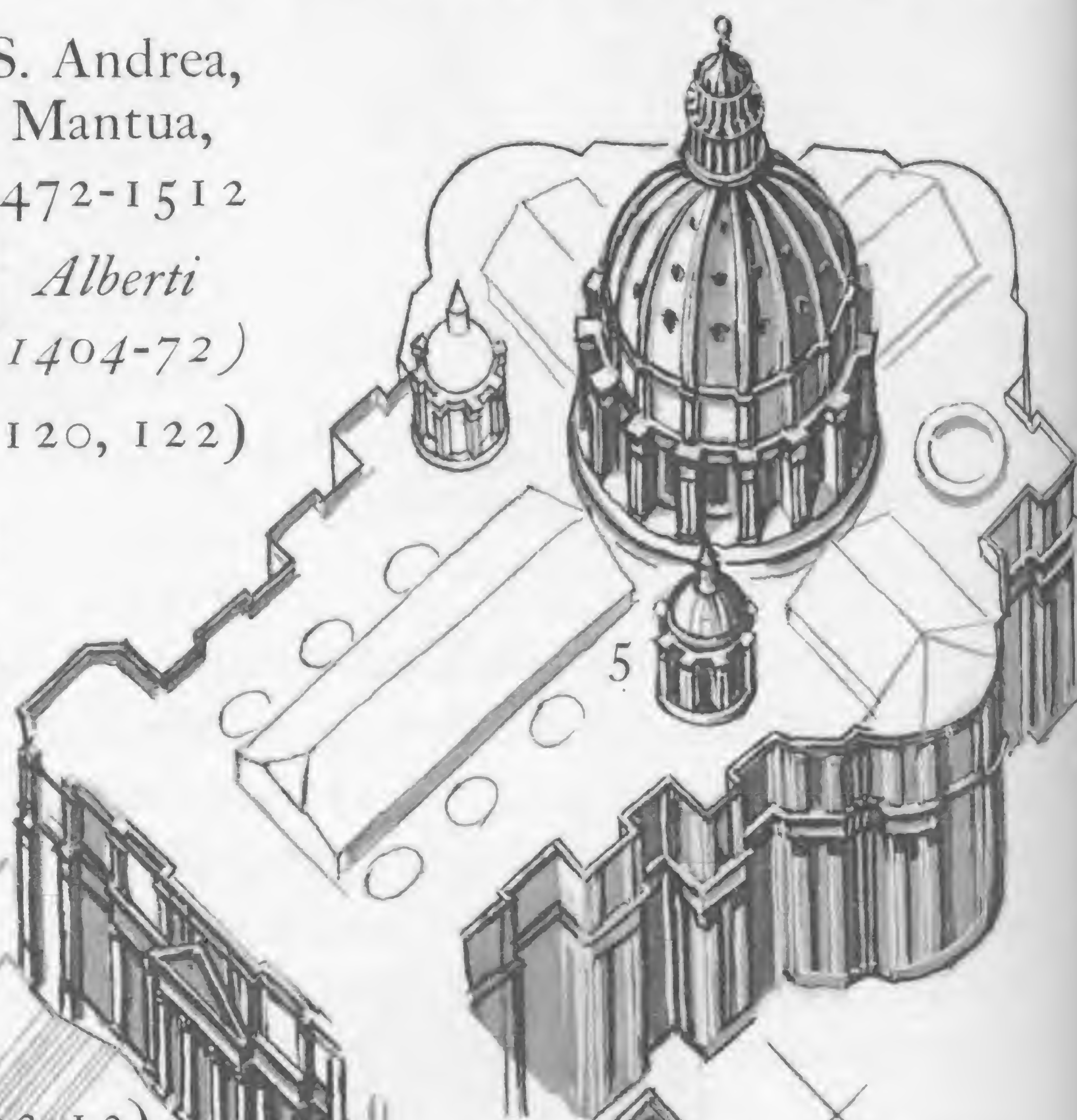
Florence  
Cathedral:  
*Brunelleschi*  
(1377-  
1446)  
(pp. 109,  
124)



the dome,  
1420-34



S. Andrea,  
Mantua,  
1472-1512  
*Alberti*  
(1404-72)  
(pp. 120, 122)



Pope Julius II (1503-13)  
had the old basilican  
church pulled down (p.70),  
and successive plans were  
made for the new church:

1 *Bramante* (1444-1514)  
1506

2 *Raphael* (1483-1520)  
1515-20

3 *Sangallo the Younger*  
(1485-1546)  
1539

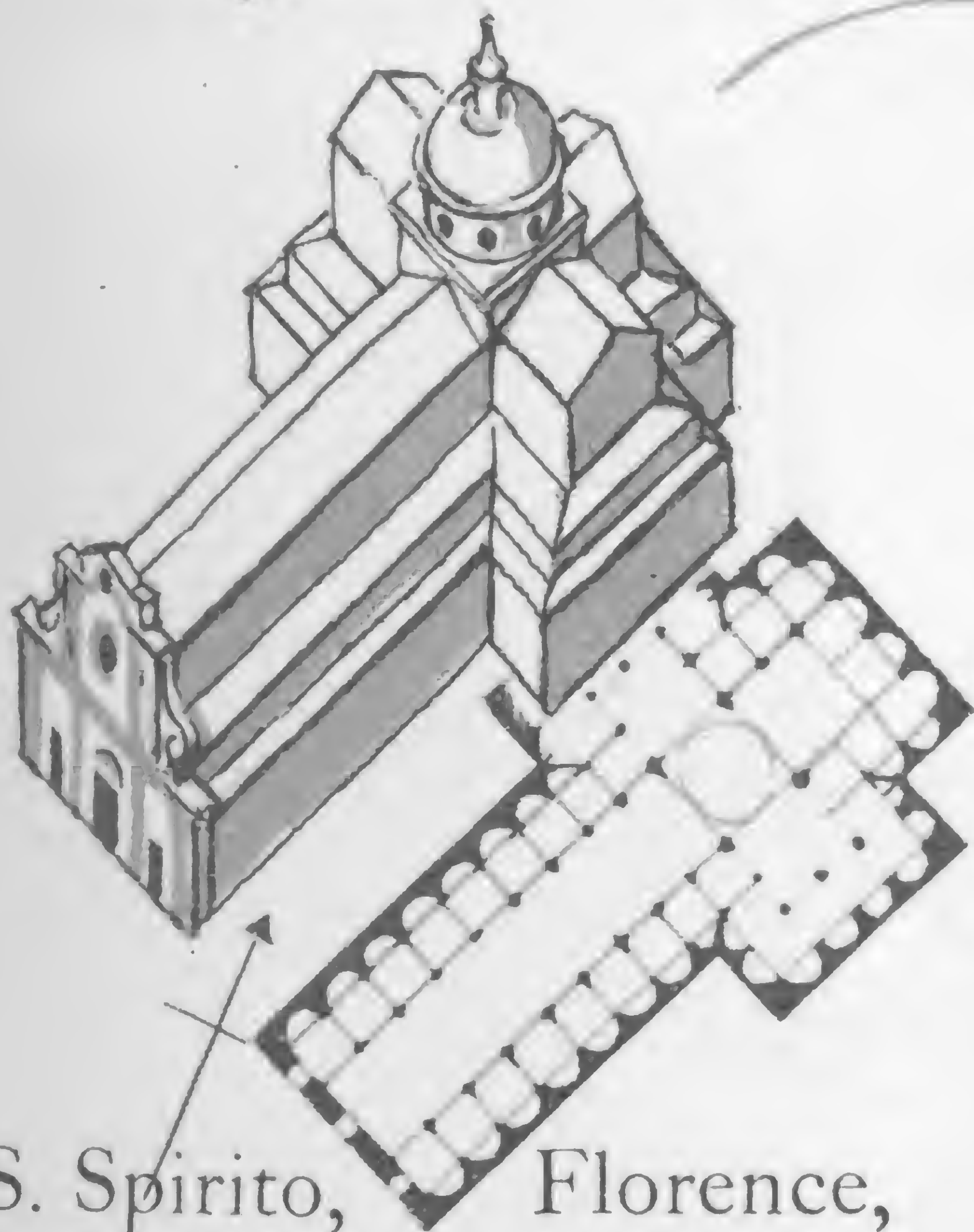
4 *Michelangelo* (1474-1564)  
1546-64

also designed the dome,  
completed 1585-90

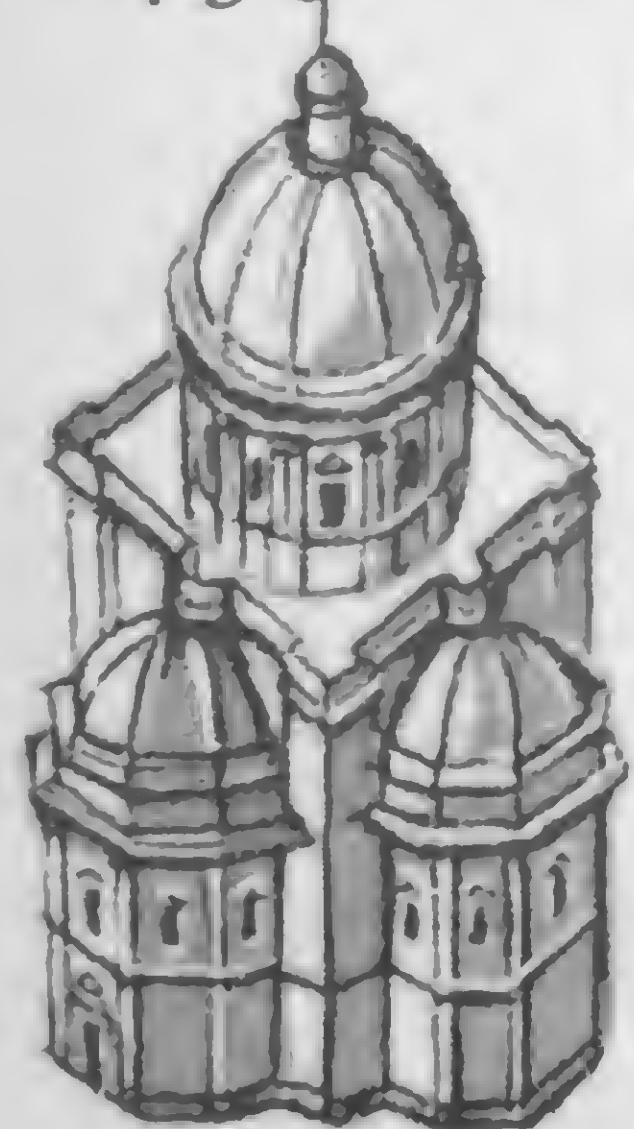
by *Giacomo della Porta*  
(1541-1604)  
and *Domenico Fontana*  
(1543-1607);

5 side cupolas added 1564,  
by *Vignola* (1507-73)

6 *Carlo Maderna*  
(1556-1629) lengthened  
nave to form a Latin cross  
& added the façade 1606-12



S. Spirito, Florence,  
1435 *Brunelleschi*  
(p.122)



S. Maria della Consolaz-  
ione, 1508, *Bramante*  
& *Cola di Caprarola*

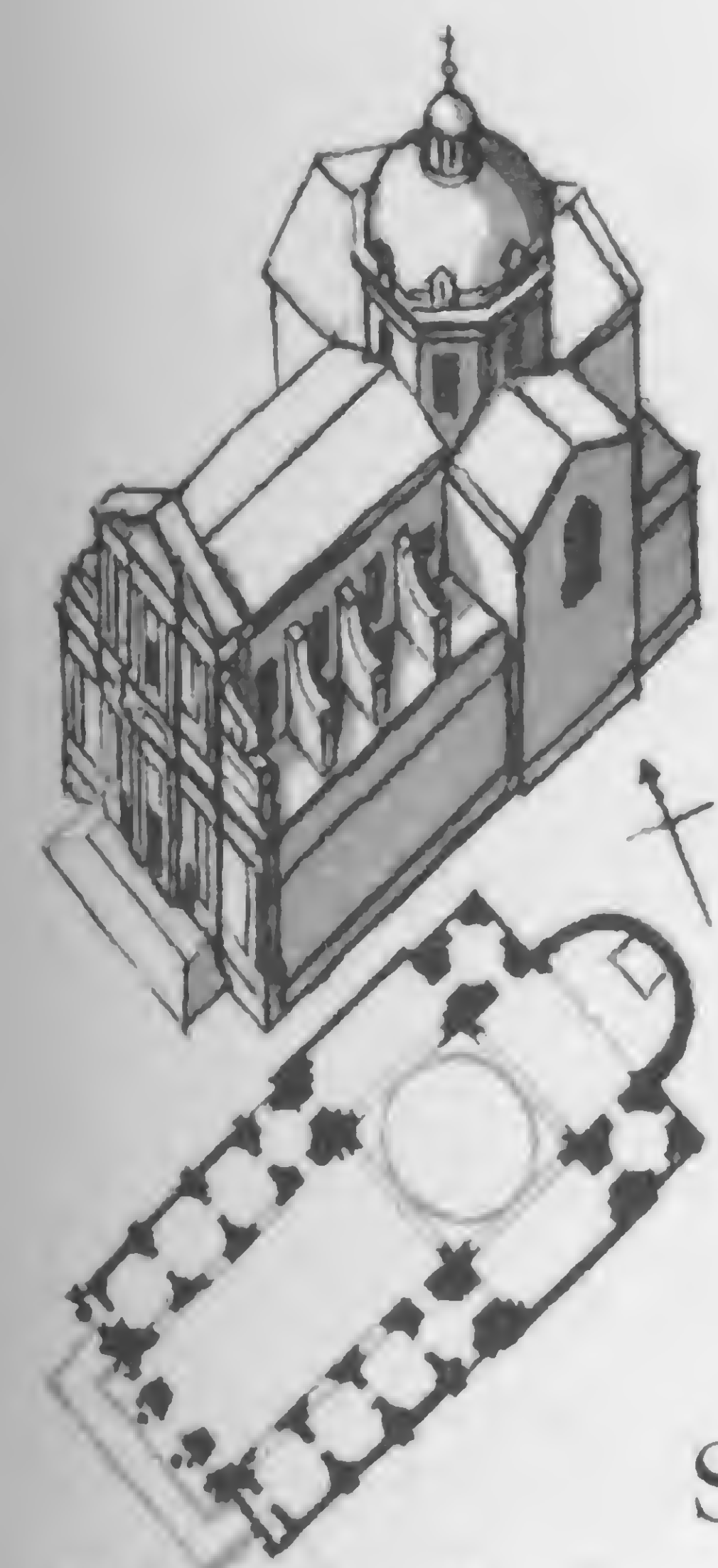
St Peter's, Rome, 1506-1612 (pp. 93, 124)



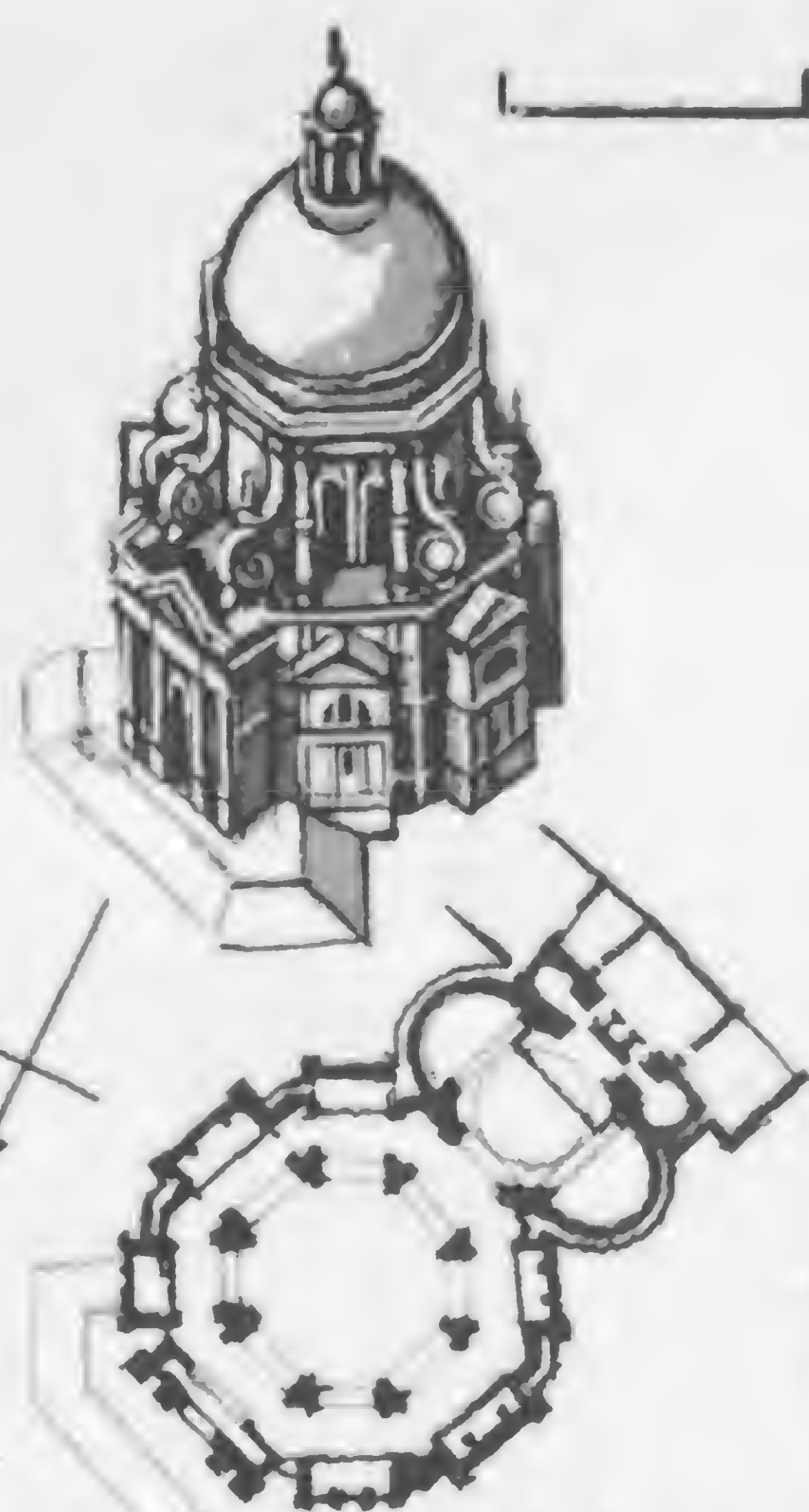
# PLANS & ELEVATIONS

plans and elevations  
to the same scale

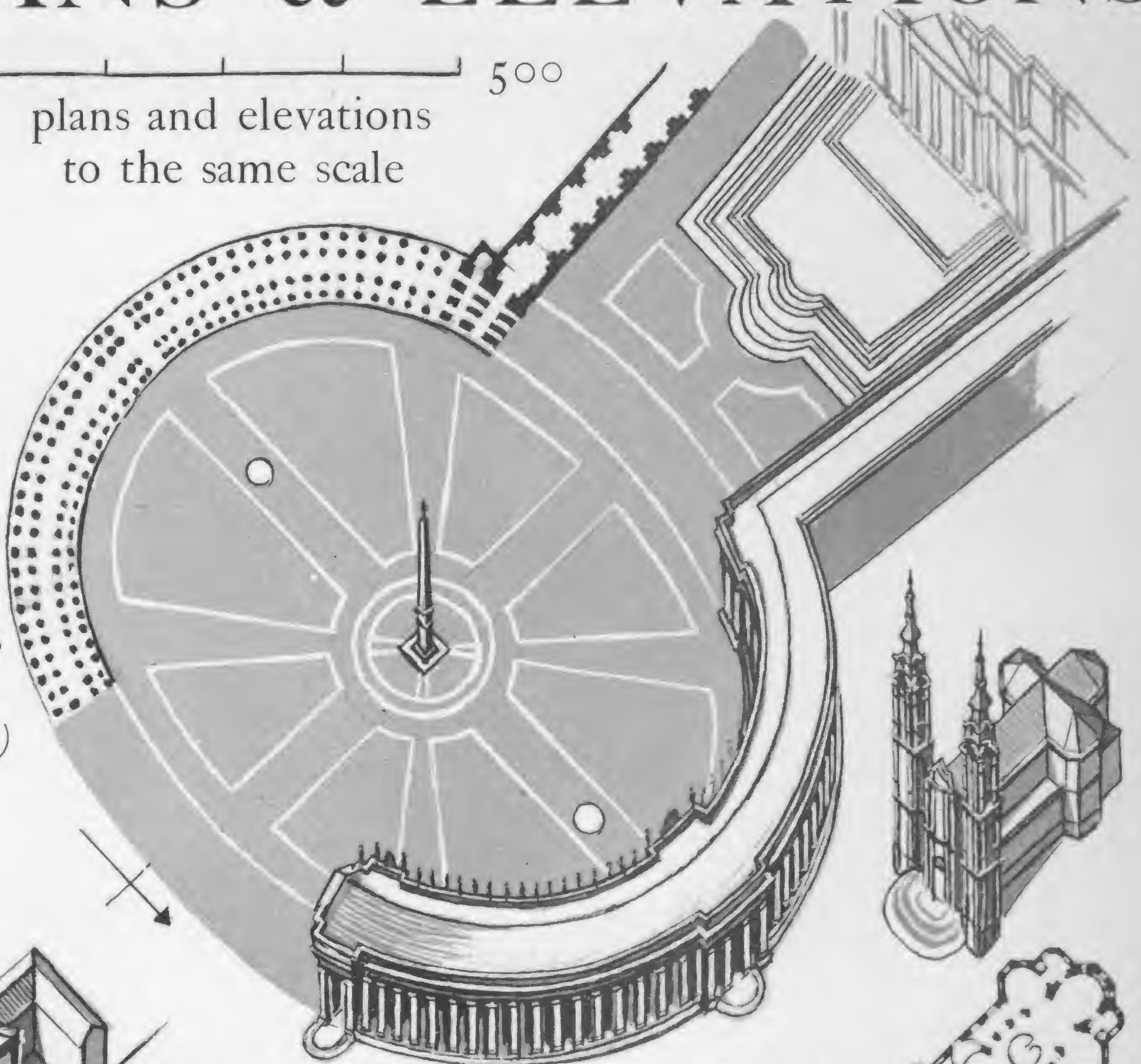
500



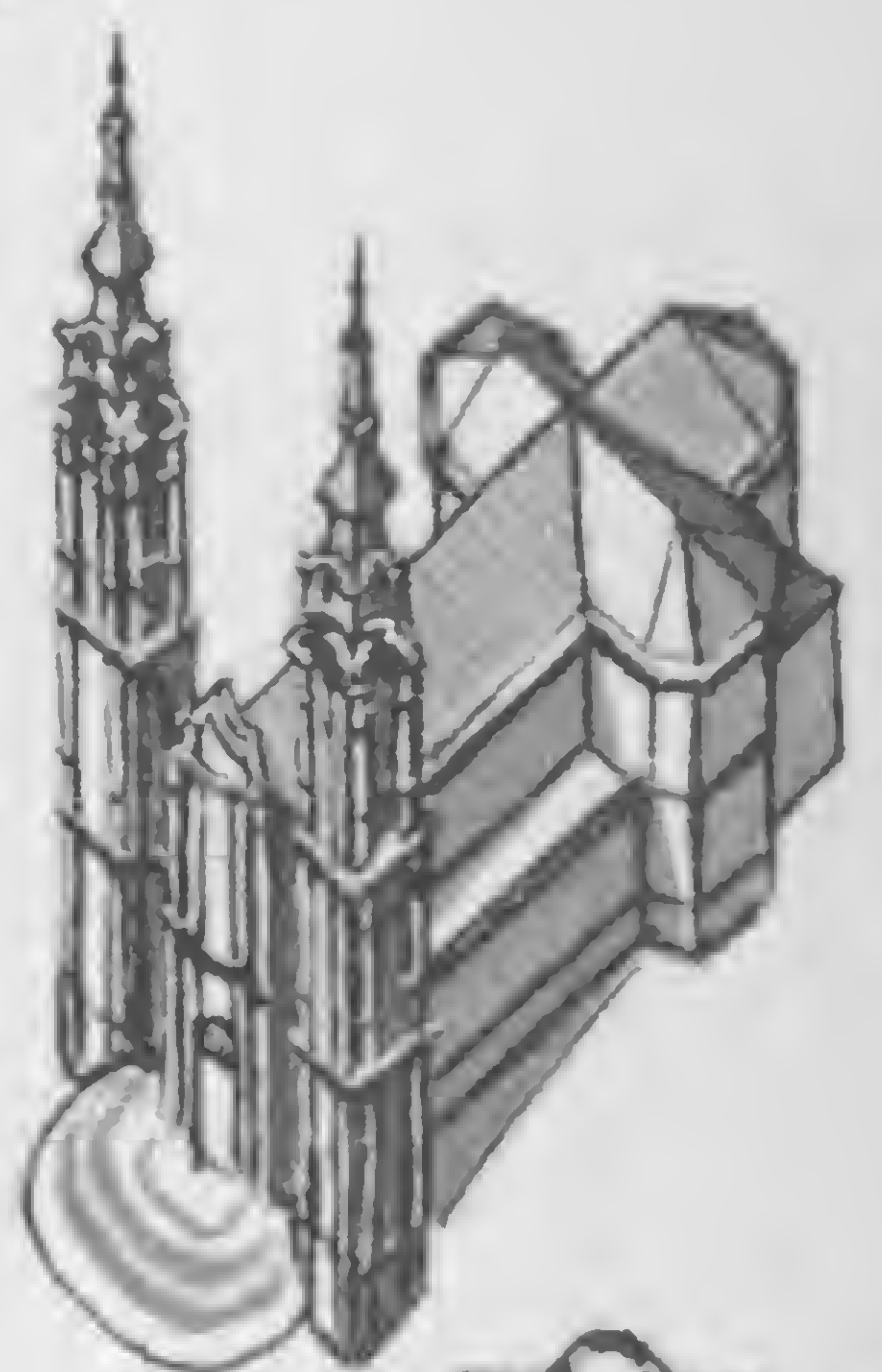
The Gesù,  
Rome,  
1568-75  
*Vignola*  
(1507-73)  
(pp. 120,  
122)



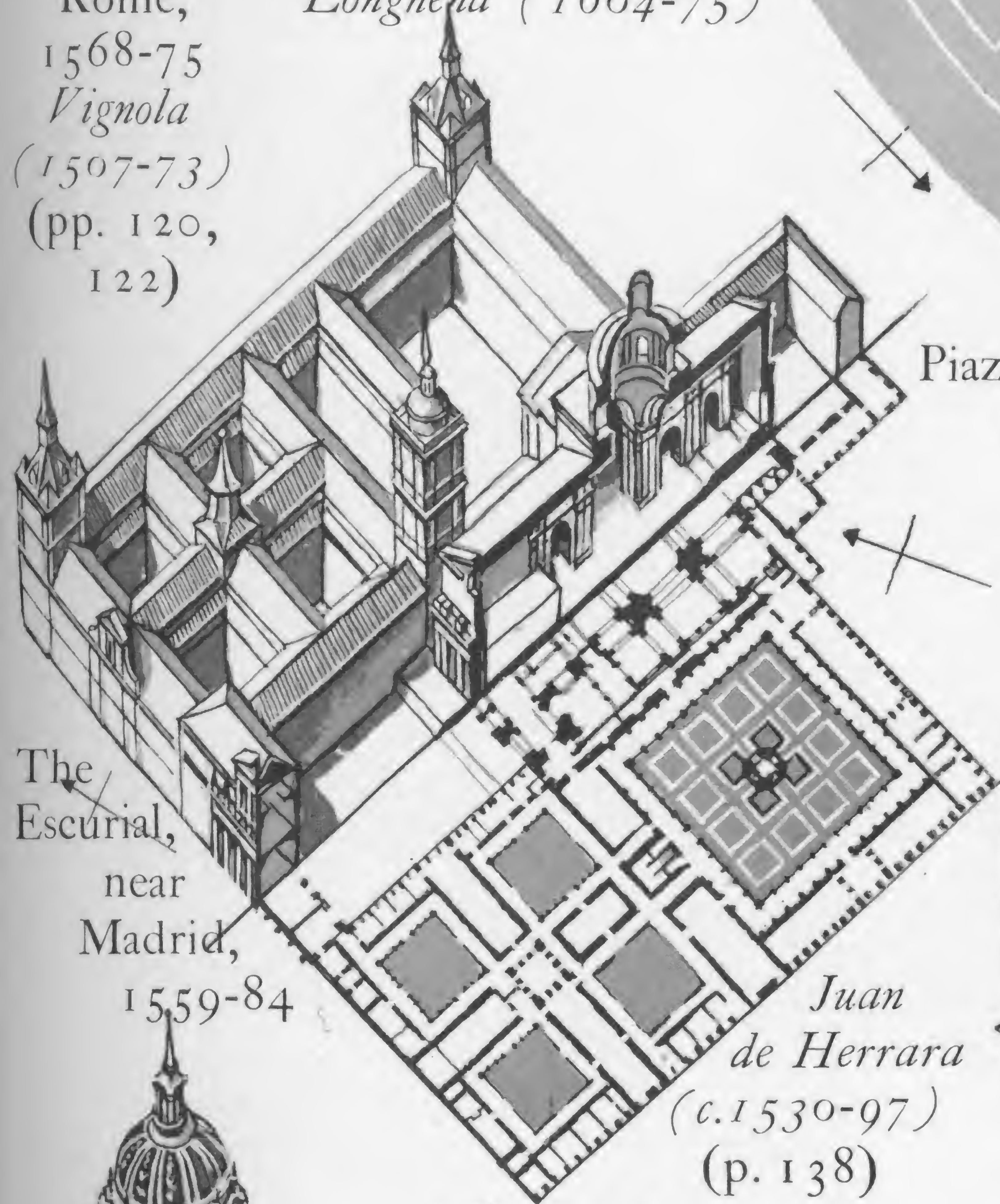
S. Maria della Salute,  
Venice, 1632  
*Longhena* (1604-75)



Piazza, St Peter's, Rome, 1655-67  
*Bernini* (1589-1680)



Vierzehnheiligen,  
S. Germany,  
1744-72 *Neumann*  
(1687-1753)  
(p. 137)



The  
Escorial,  
near  
Madrid,  
1559-84

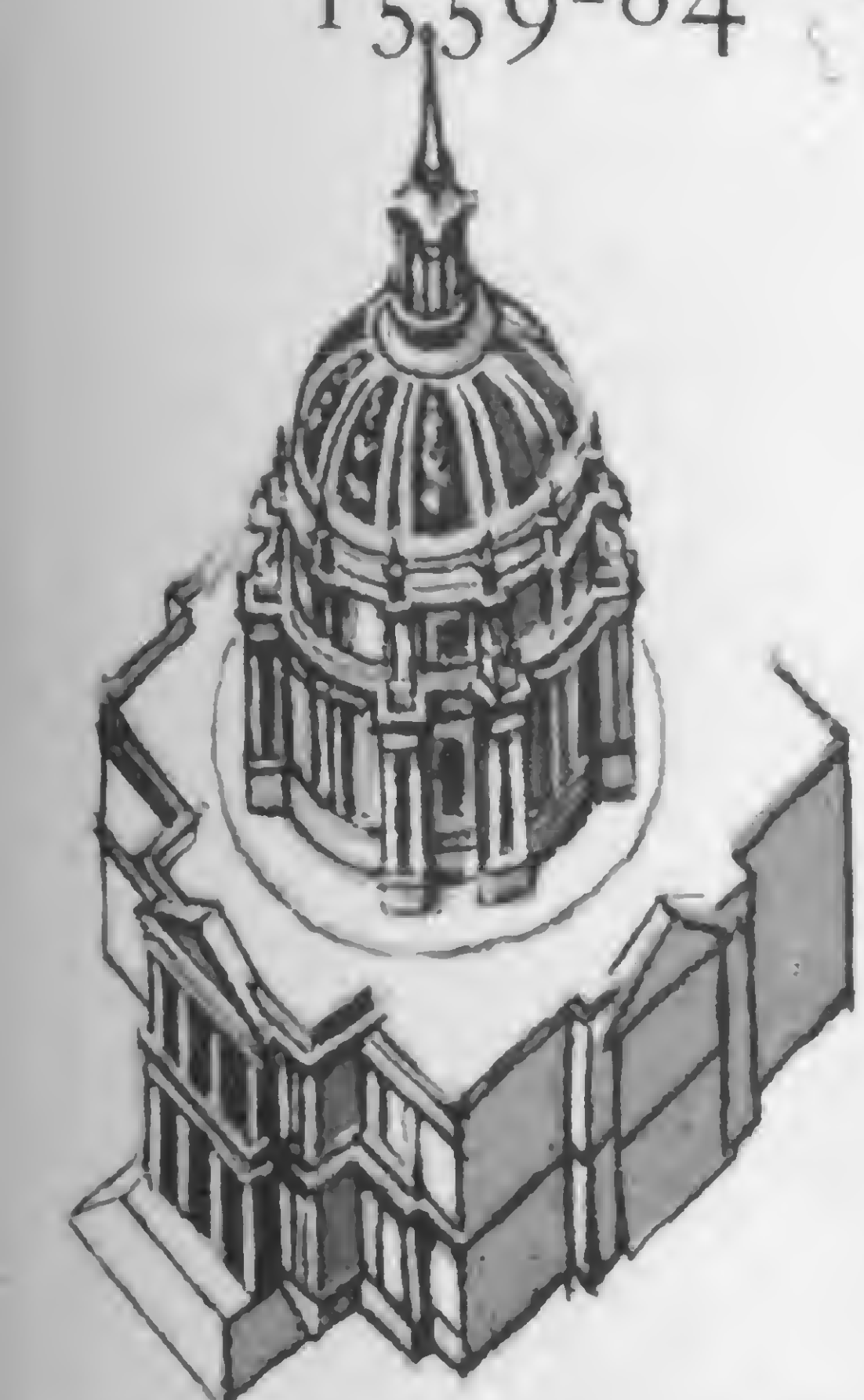
*Juan  
de Herrera*  
(c.1530-97)  
(p. 138)



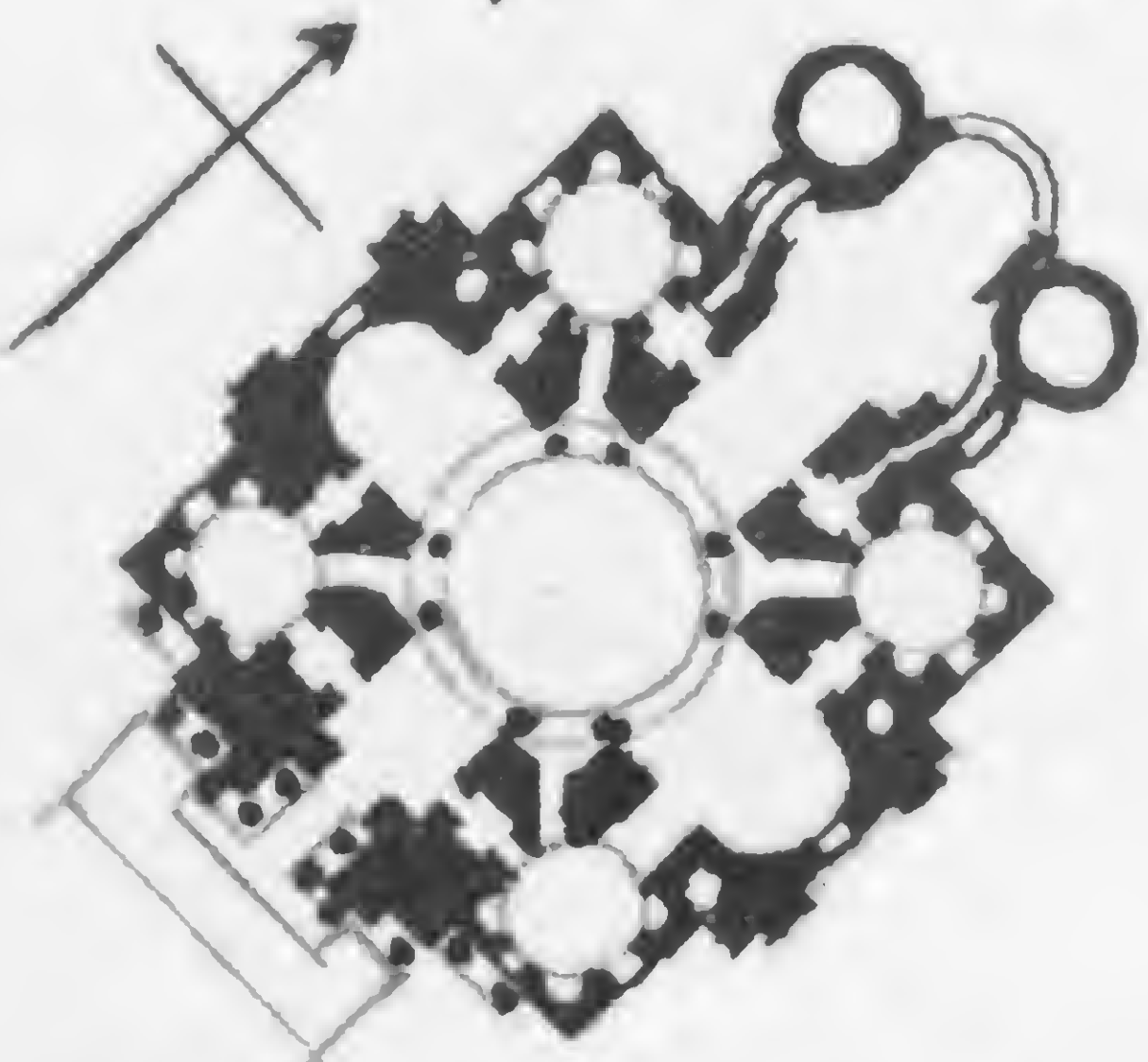
St Paul's Cathedral, London,  
1675-1710  
*Sir Christopher Wren* (1631-1723)  
(pp. 144-145)



Karlskirche,  
Vienna,  
1716-29  
*J. B. Fischer  
von Erlach*  
(1656-1725)



The Dome of the Invalides, Paris,  
1693-1706  
*J. H. Mansart*  
(1646-1708) (pp. 125, 131)





# RENAISSANCE - BAROQUE

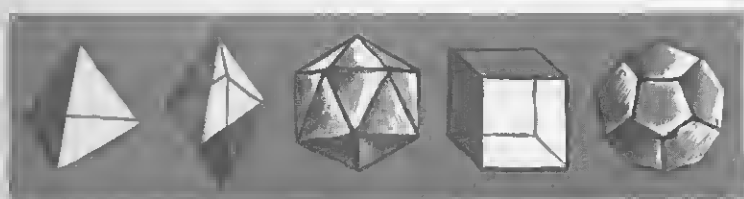
Sources of Italian architectural theory:

1. The study of Roman buildings.
2. The Platonic-Aristotelian description of God and the Universe as a perfect circle.
3. The Pythagorean, and Medieval, idea of Man as the microcosm of the Universe (the macrocosm).
4. The linking of Geometry and Music, two of the Seven Liberal Arts:

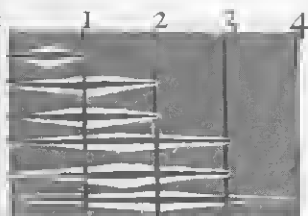
'Geometry makes visible the musical consonances' (Boethius, *De Musica*, c.500).  
In Florence Cosimo de Medici (1389-1462) founded the Platonic Academy.



gives an account of the creation and geometrical form of the universe. He represents the four basic elements and the cosmos as:

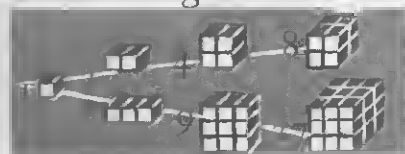


these 'Platonic' bodies are the 5 regular solids. The elements of the cosmos, as well as its soul-substance & its motion, were created proportionate to musical ratios based on Pythagoras (582-c.507 B.C.) He 'regarded numbers as the elements of all things and the whole heaven as a numerical scale' (Aristotle), & found that tones could be measured by striking cords proportionate in length.



1:2 octave  
2:3 fifth  
3:4 fourth

Plato gives the 'Harmonie' scale as:

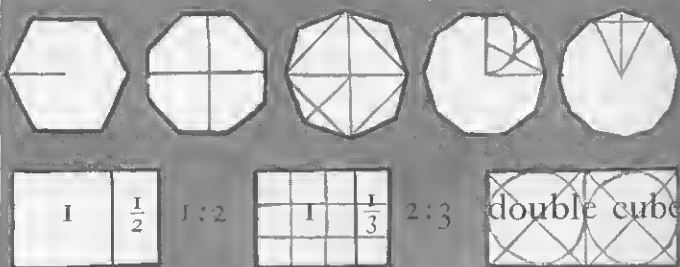


which contain the musical consonances  
1:2, 2:3, 3:4.

For Renaissance architect-theorists, churches based upon these axioms, would be microcosms of the universe of God:  
'... the little temples we make ought to resemble this very great one' (Palladio).

Marcus Vitruvius Pollio  
*The Ten Books on Architecture*  
Roman architect & engineer 1st century B.C.

Vitruvius  
(edited by Fra Giocondo)  
Venice, 1511

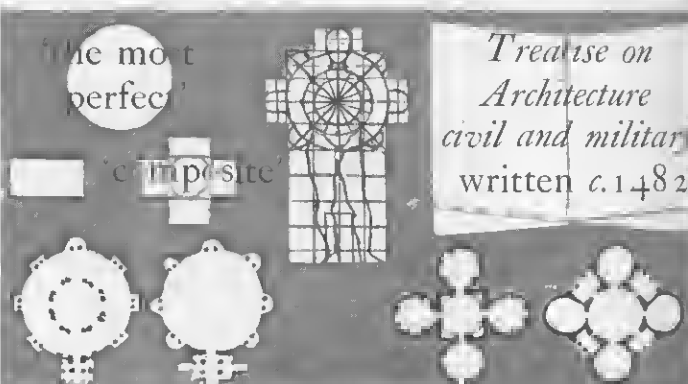


Ideal plans for churches (VII, 4)

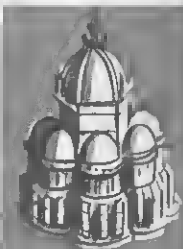
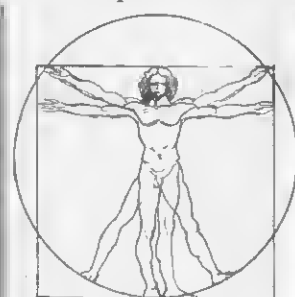
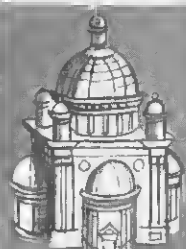
'Of all these numbers. . .  
(1:2 octave, *diapason*;  
2:3 fifth, *sesquialtera*;  
3:4 fourth, *diatessaron*)  
... the architects make  
very convenient use' (IX, 5)

*Ten Books on Architecture*  
Florence 1485  
England 1726

1404—Leon Battista Alberti—1472  
Florentine architect and theorist



1439—Francesco di Giorgio—1502  
Sienese sculptor and architect

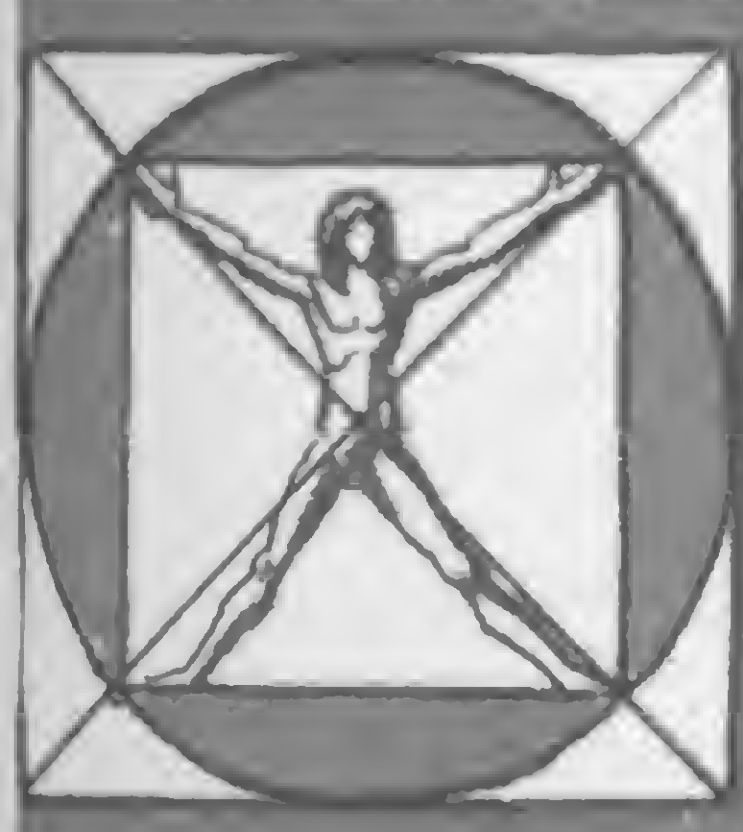


Based on  
Vitruvius (III, 1)  
from drawings by

1452—Leonardo da Vinci—1519



# THE DIVINE PROPORTIONS

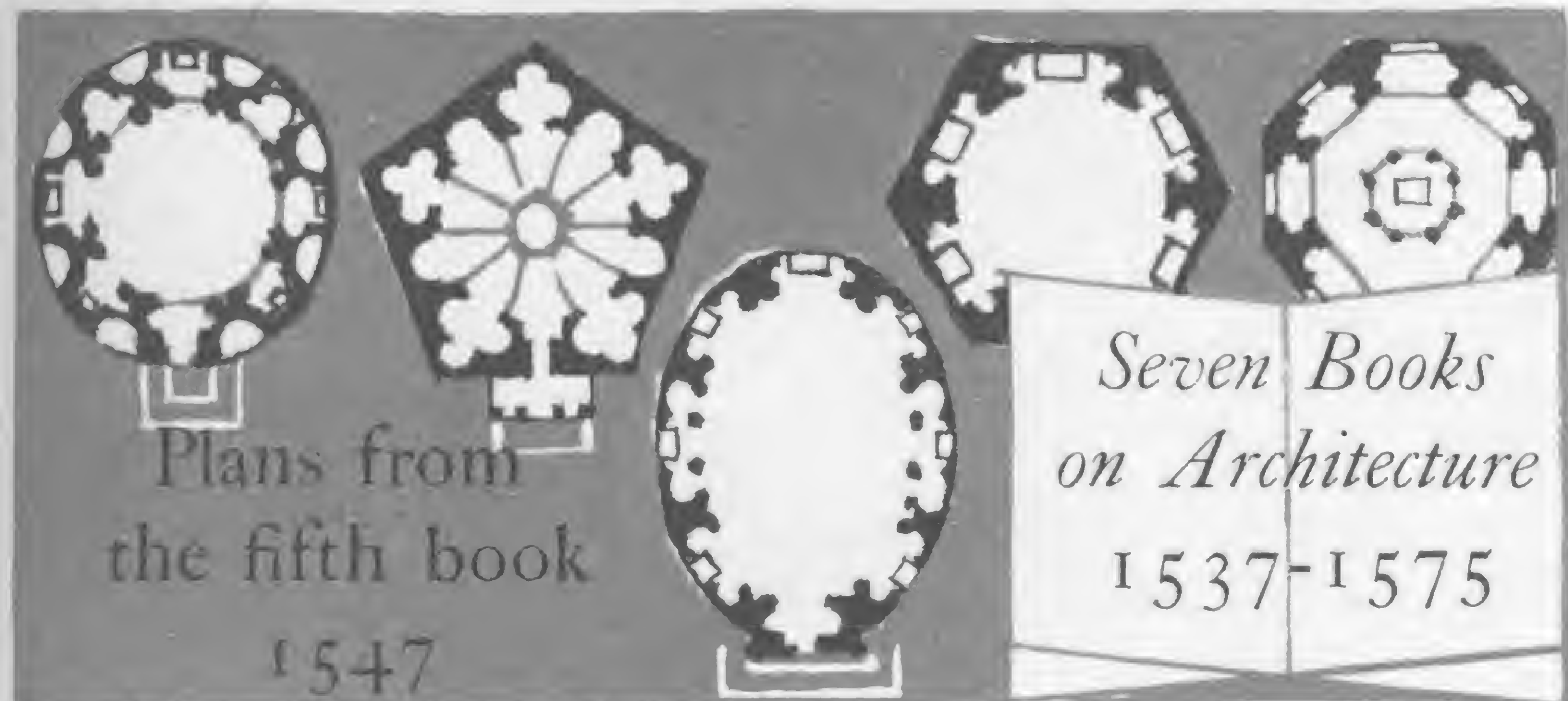


Vitruvius  
(edited by  
Cesarino),  
Como, 1521

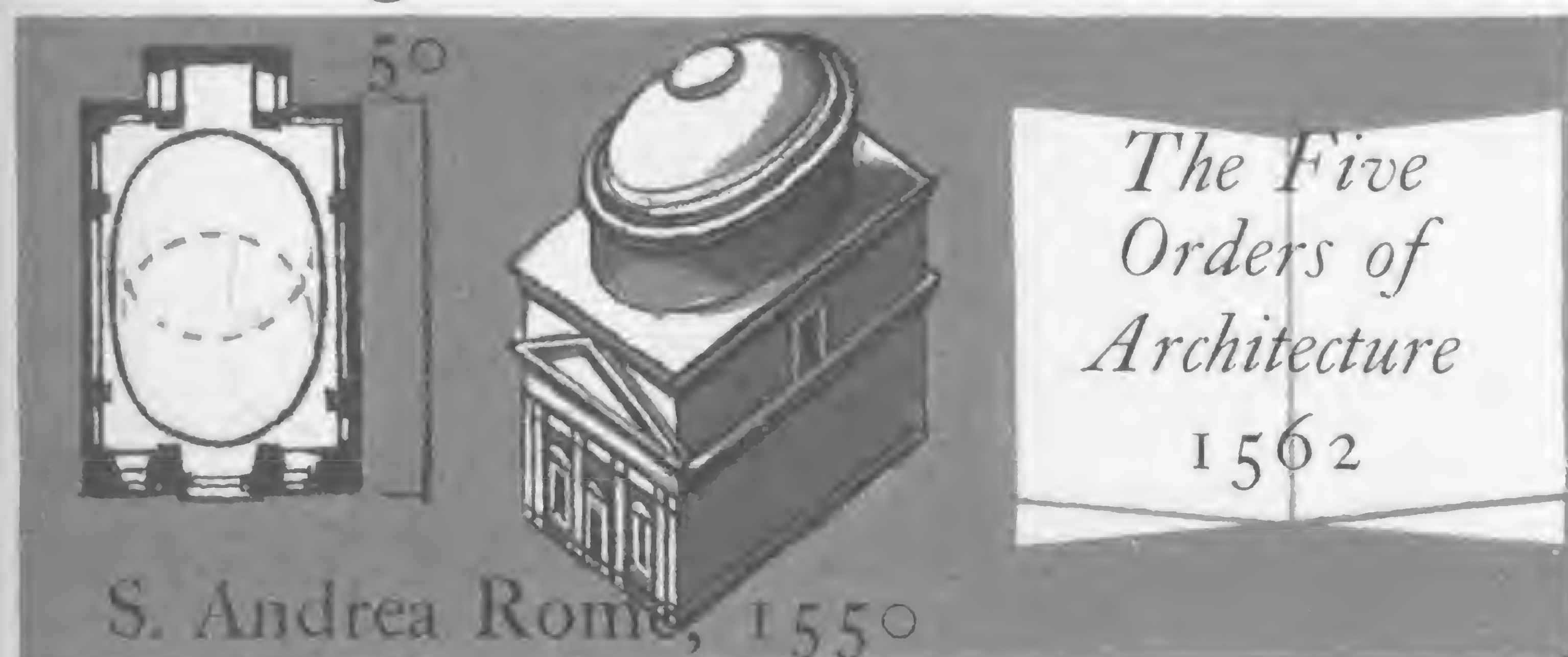
Vitruvius  
(edited by Barbaro,  
illustrated by Palladio),  
Venice, 1556

*Architecture de Vitruve  
ou Art de bien bâtir  
mis en français*  
Jean Martin 1546

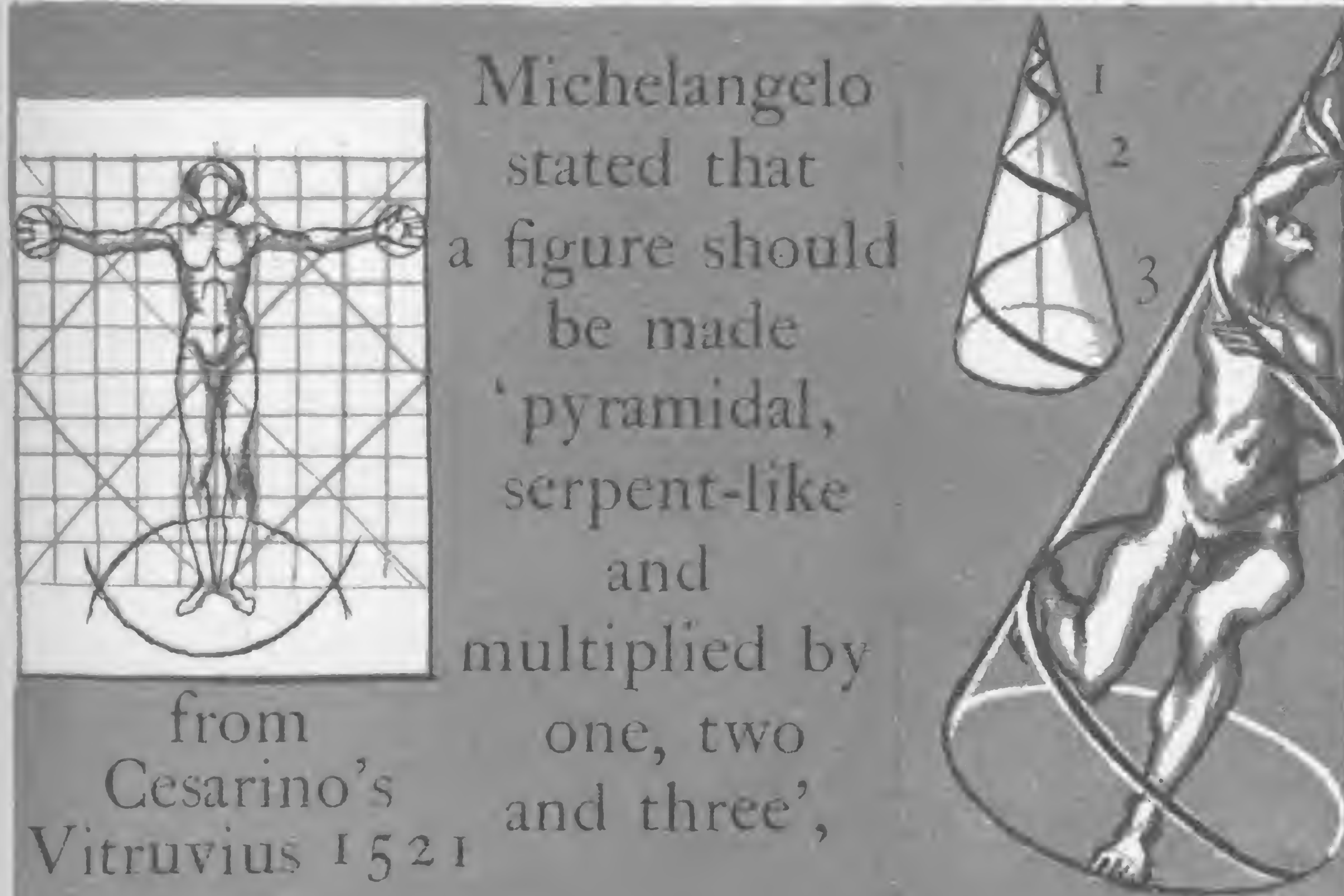
Vitruvius  
First English  
translation  
1692



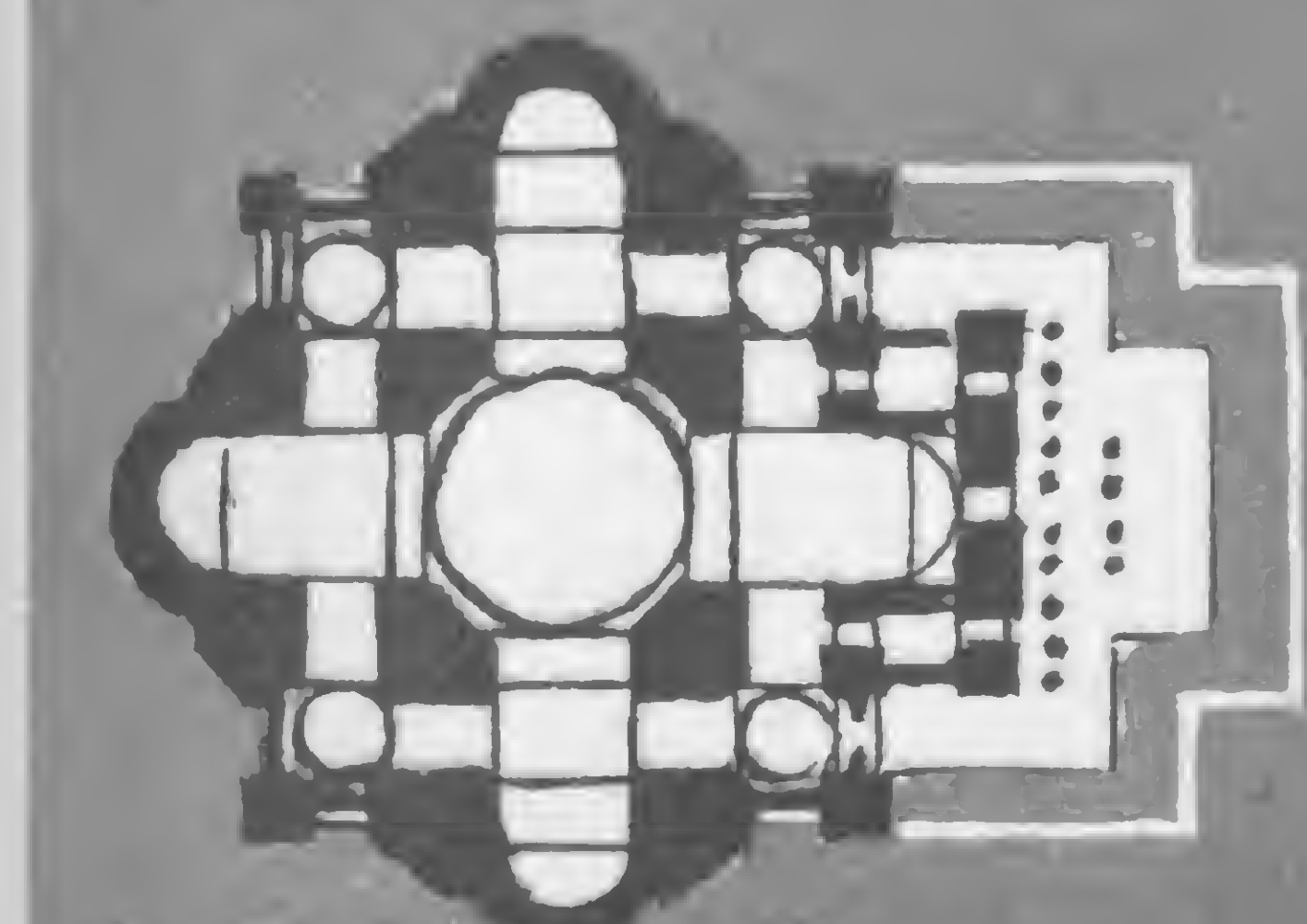
1475 — Sebastiano Serlio — 1554  
Born Bologna. Architect, worked in France



1507 — Giacomo Barozzo Da Vignola — 1573



Michelangelo  
stated that  
a figure should  
be made  
'pyramidal,  
serpent-like  
and  
multiplied by  
one, two  
and three',  
from  
Cesarino's  
Vitruvius 1521



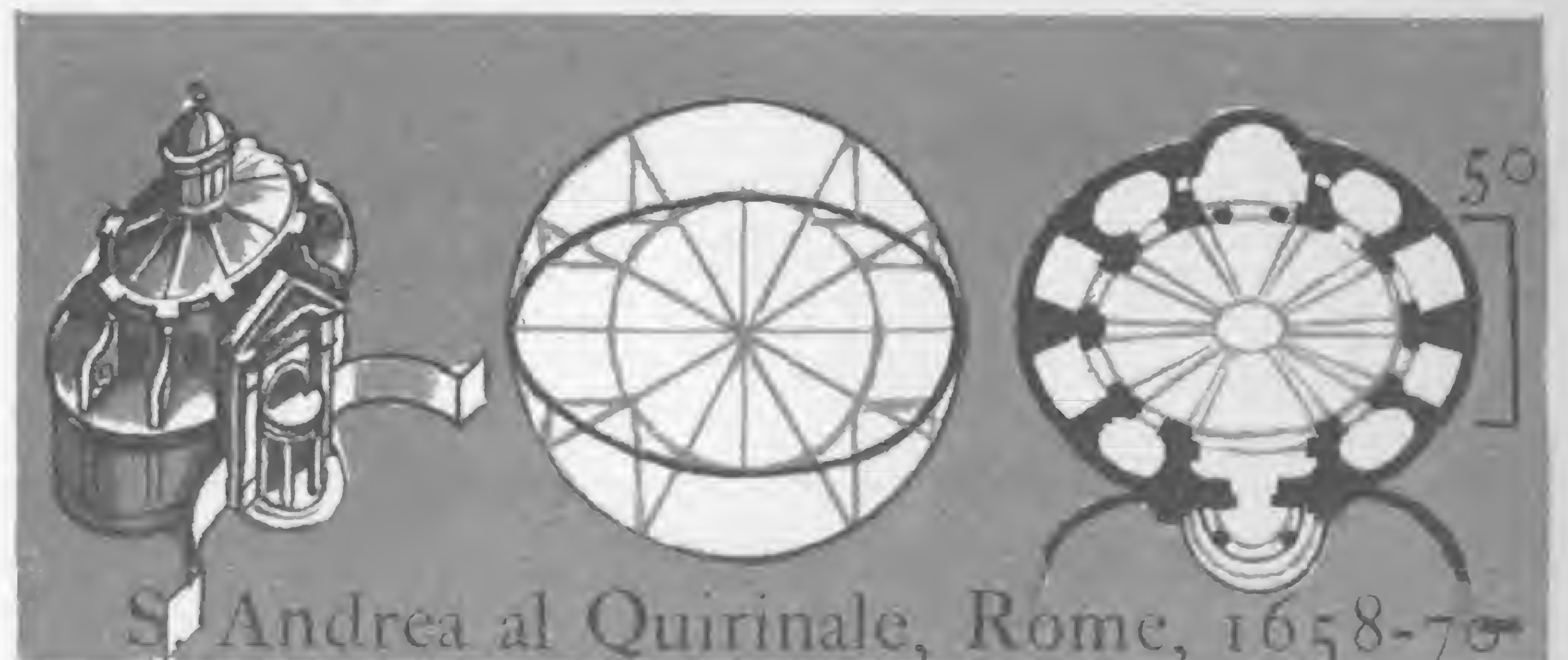
St Peter's, Rome, 1506

and wrote in a letter:  
'... the architectural  
members derive from  
human members'.

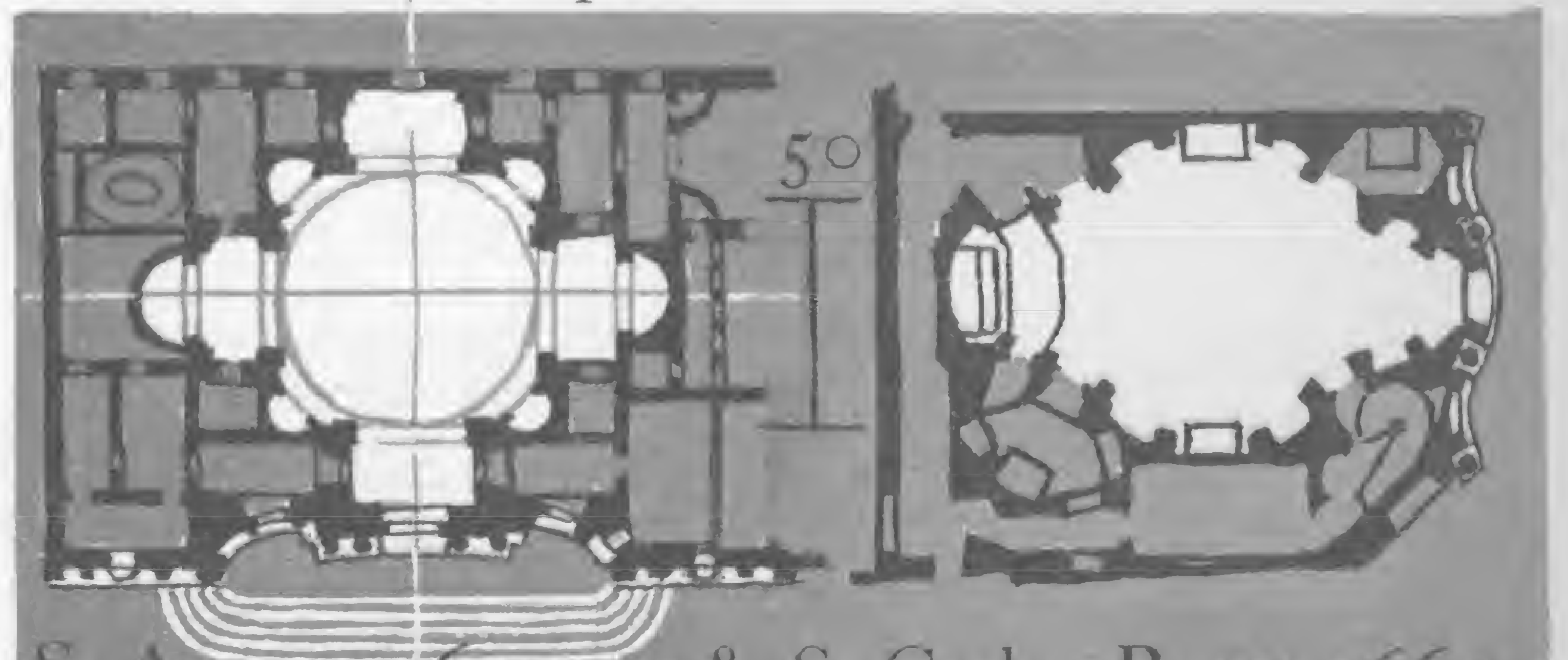
1475 — Michelangelo — 1564

1508 — Andrea Palladio (pp. 128-9) — 1580

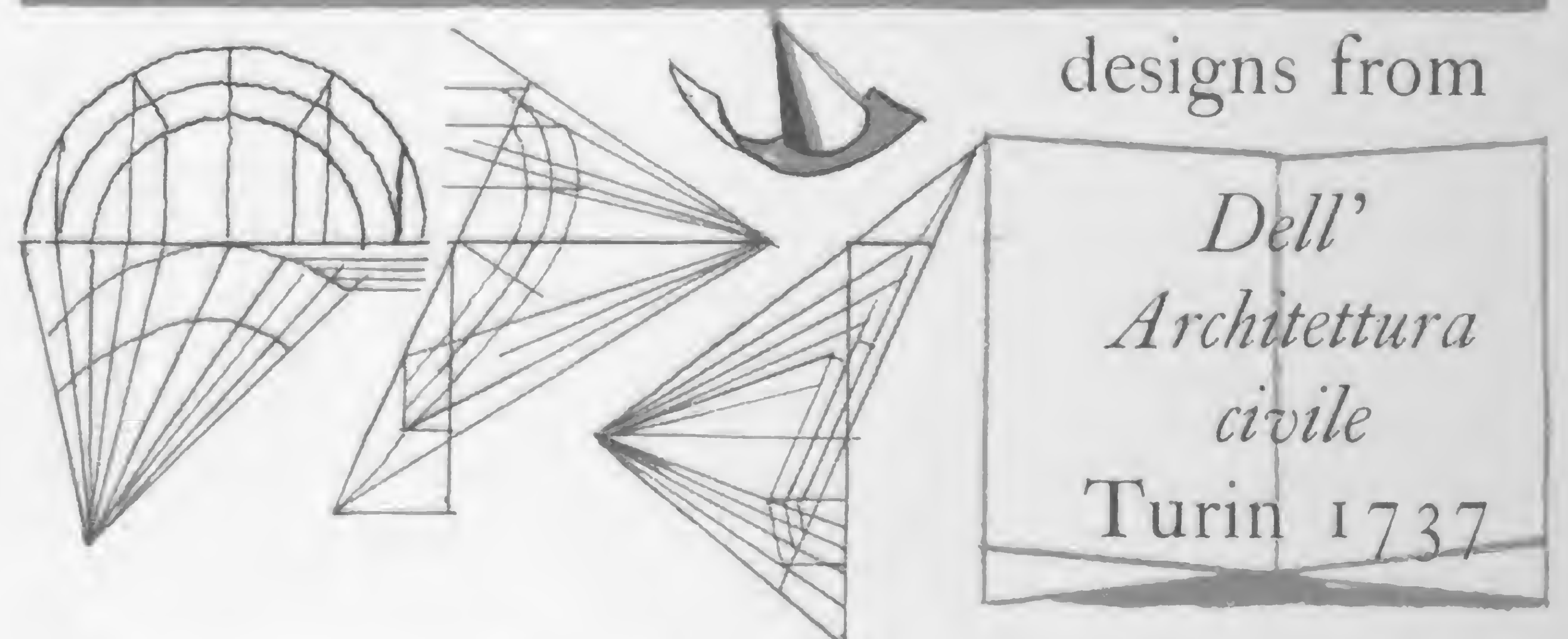
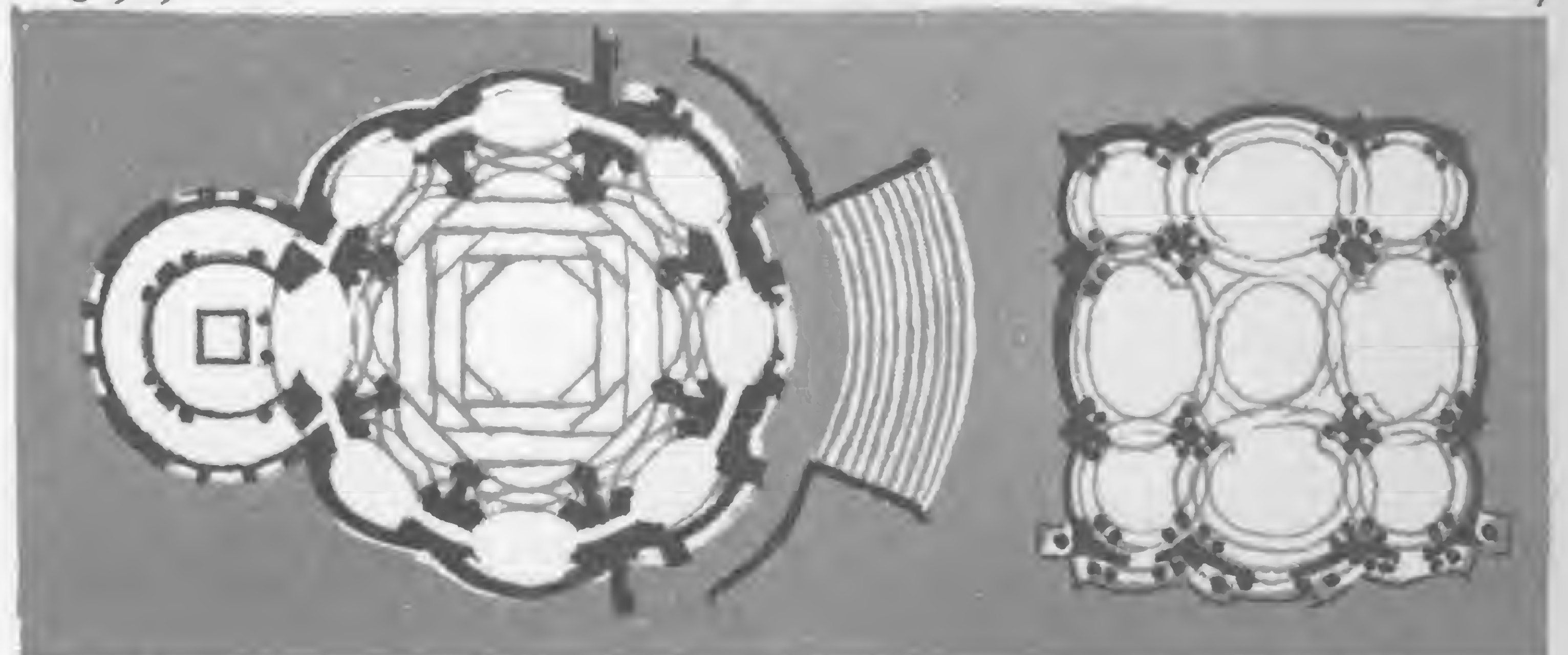
In Baroque churches musical ratios  
were resolved into an orchestration of visual  
forces comparable to the fugue, & measured  
by the eye and the mind of the beholder



1598 — Giovanni Lorenzo Bernini — 1680  
sculptor and architect



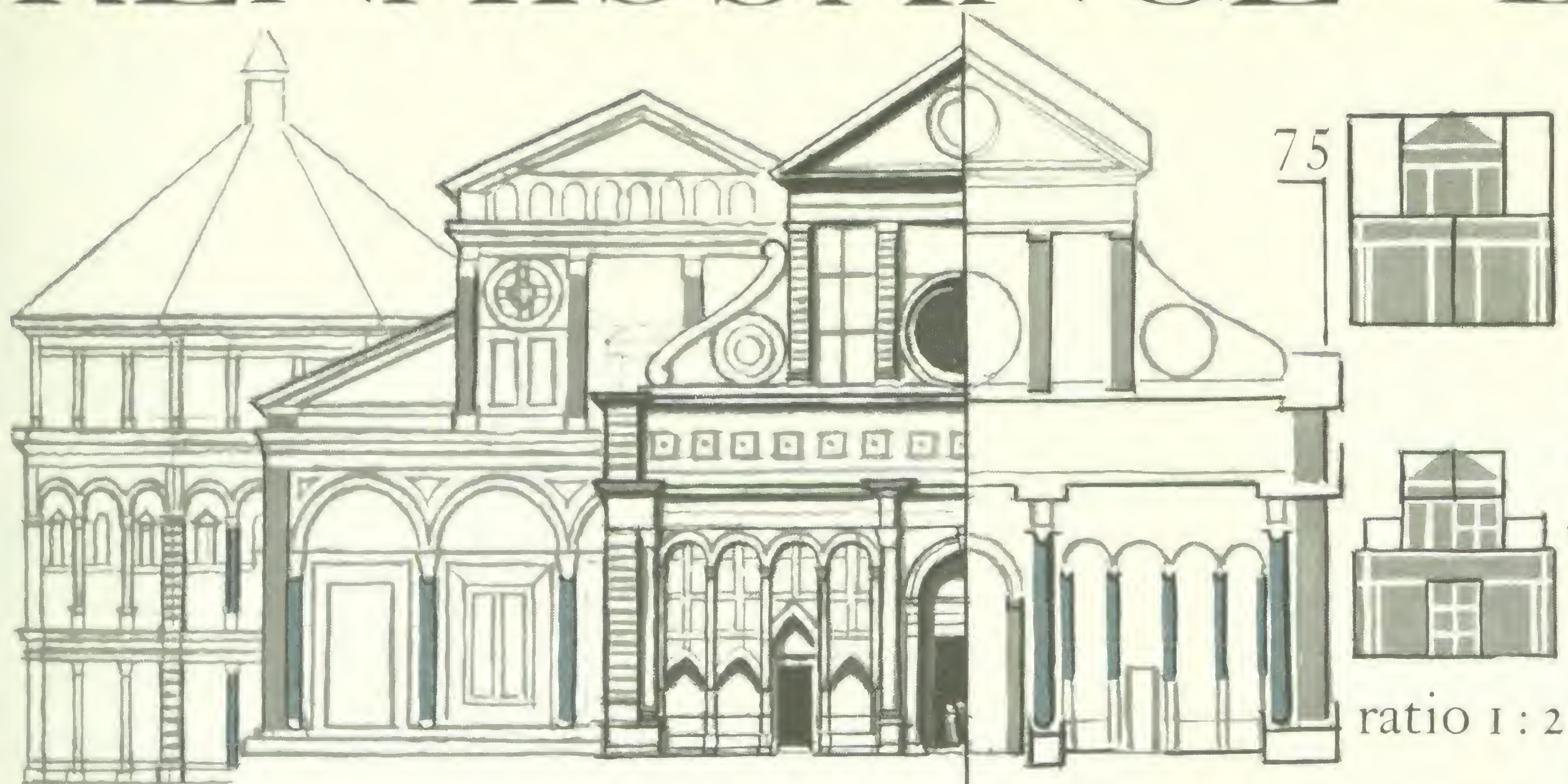
1599 — Francesco Borromini — 1667



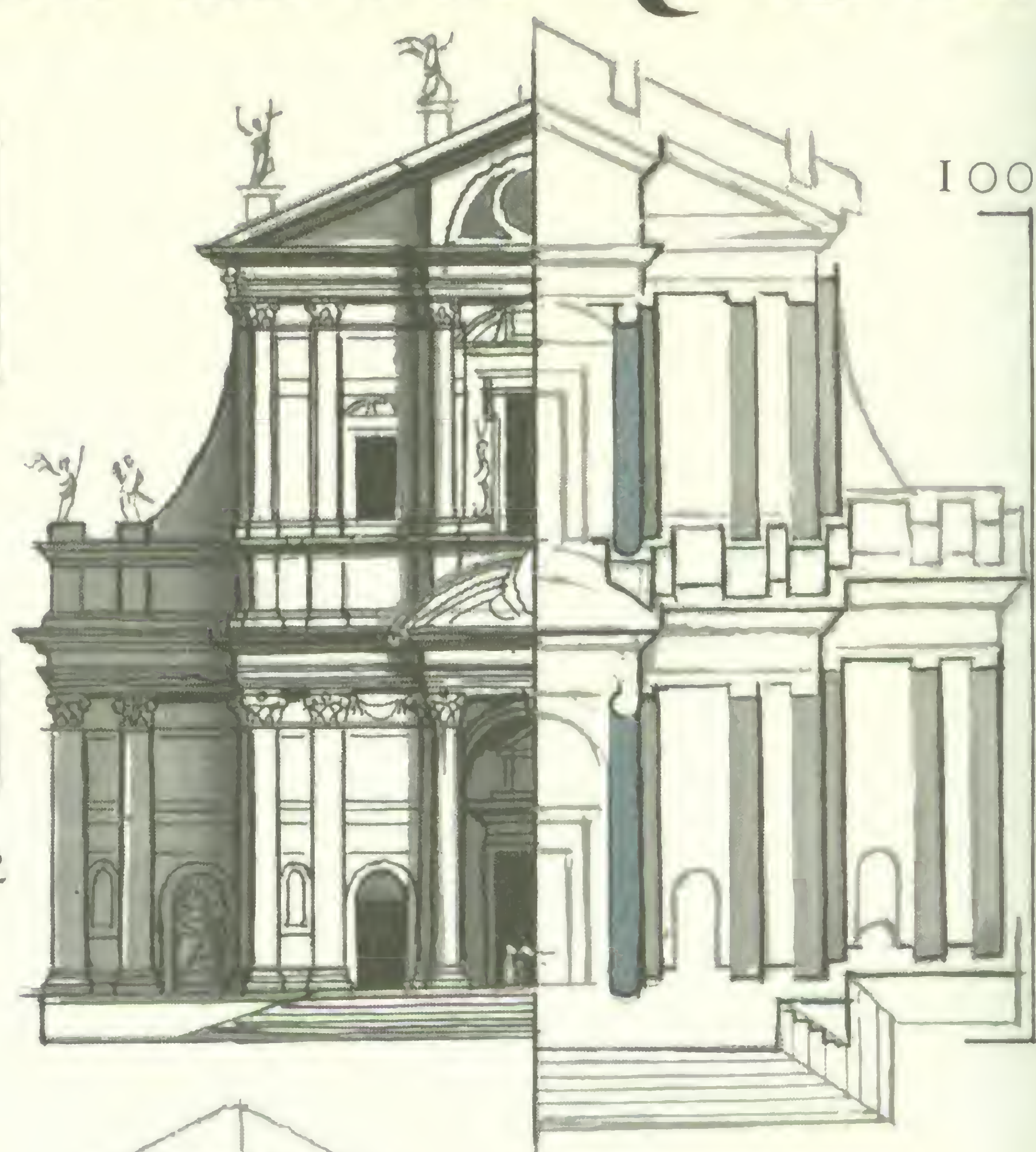
1624 — Guarino Guarini — 1683  
mathematician & architect, mostly at Turin



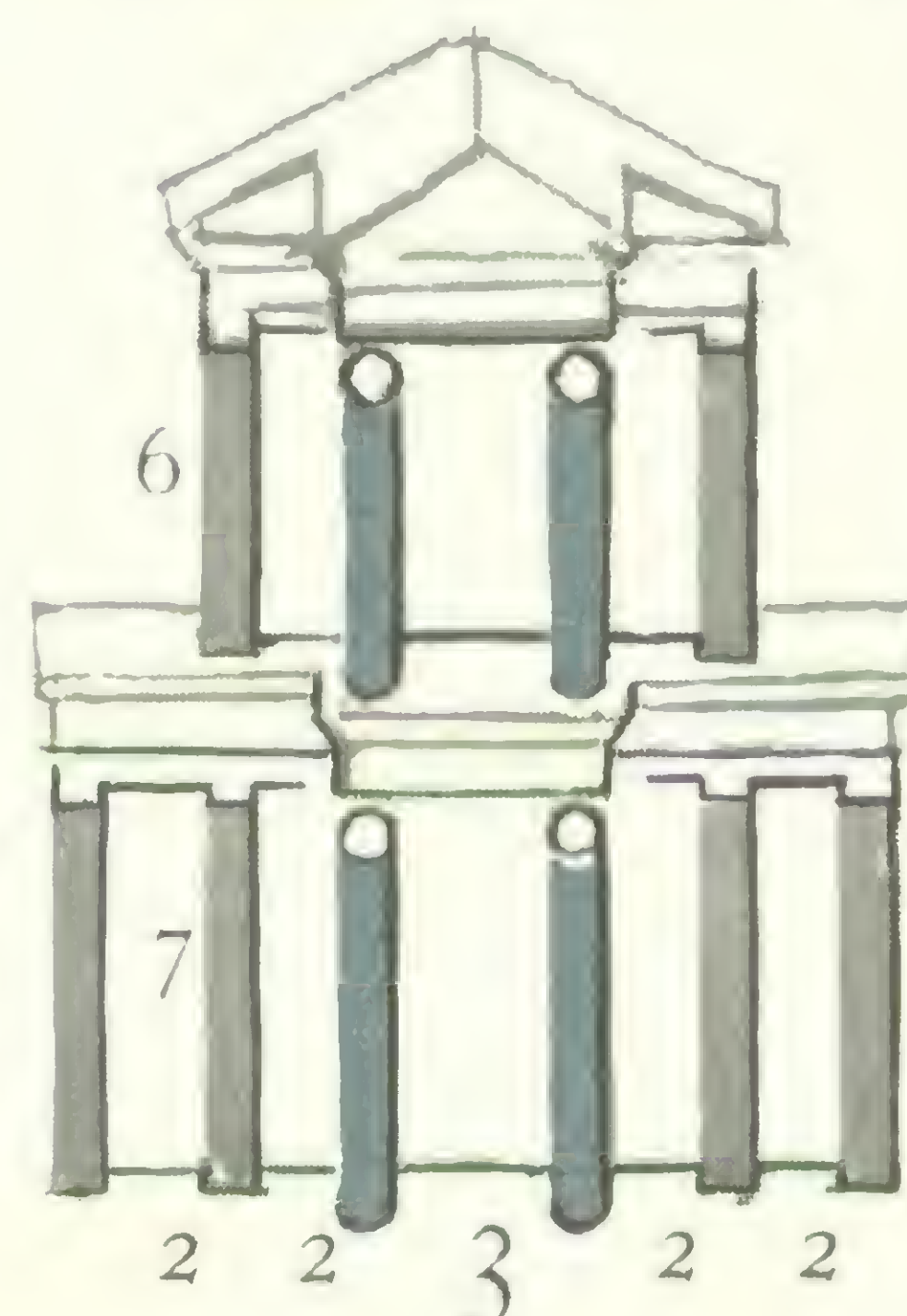
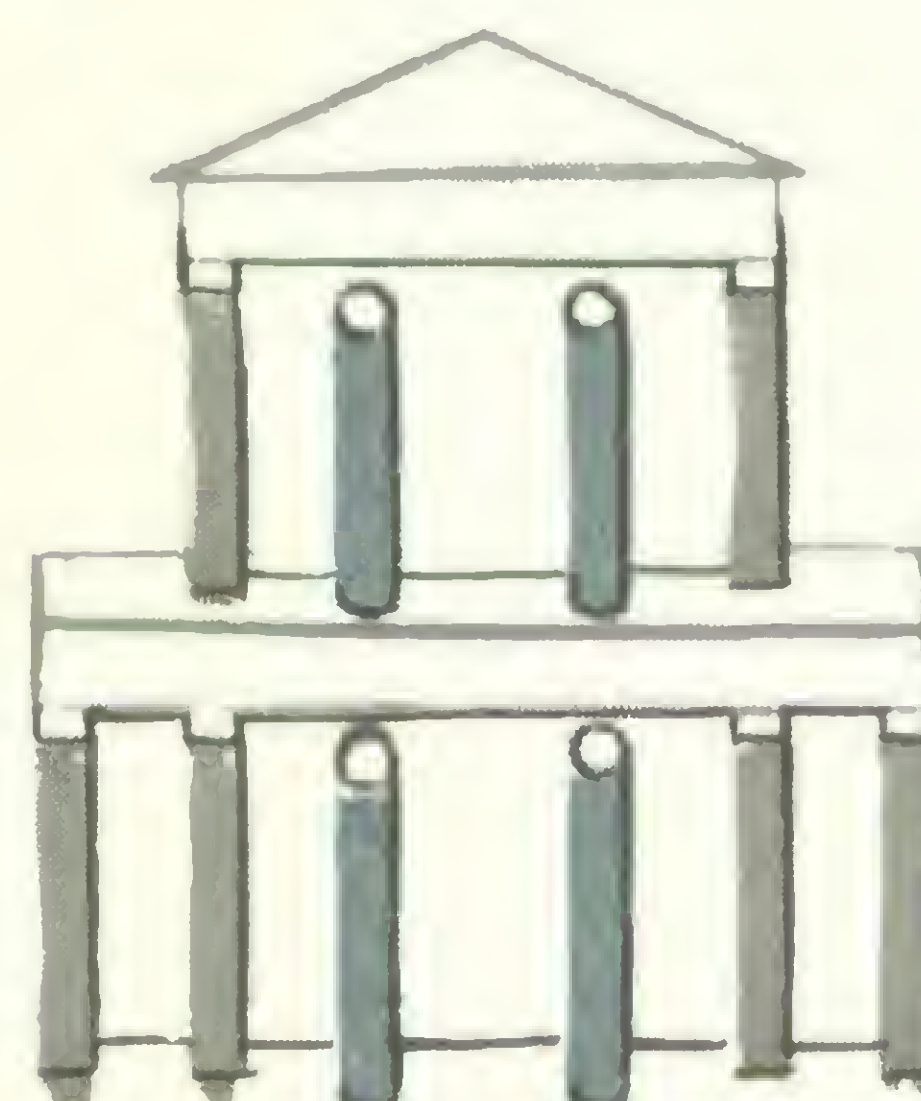
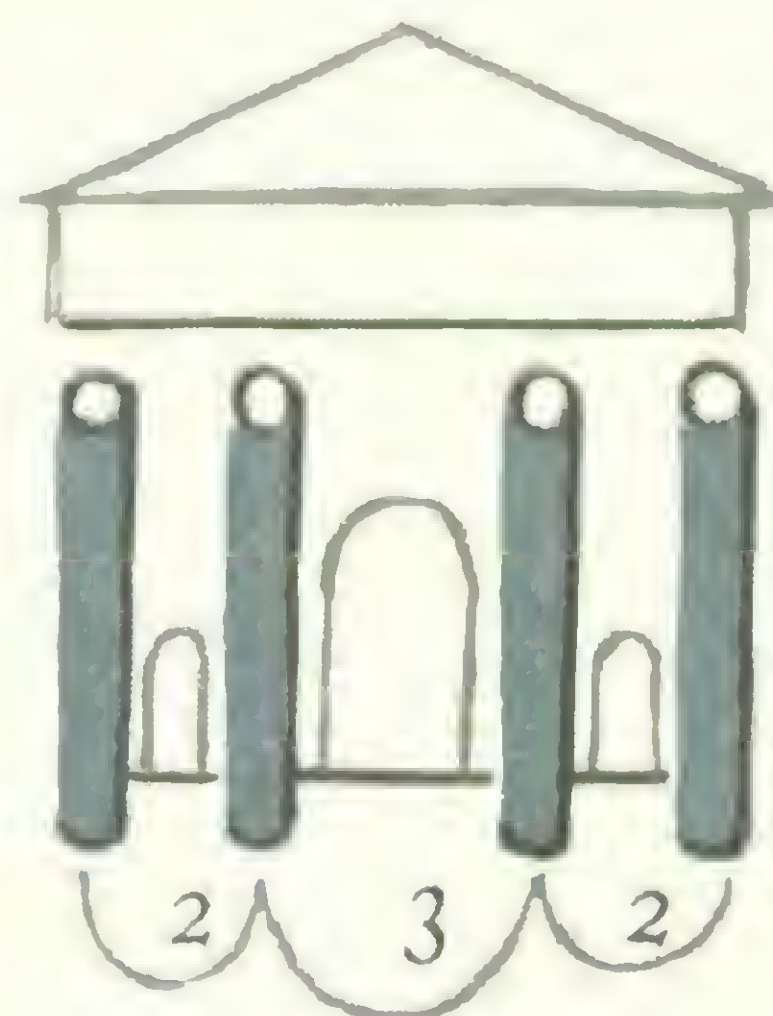
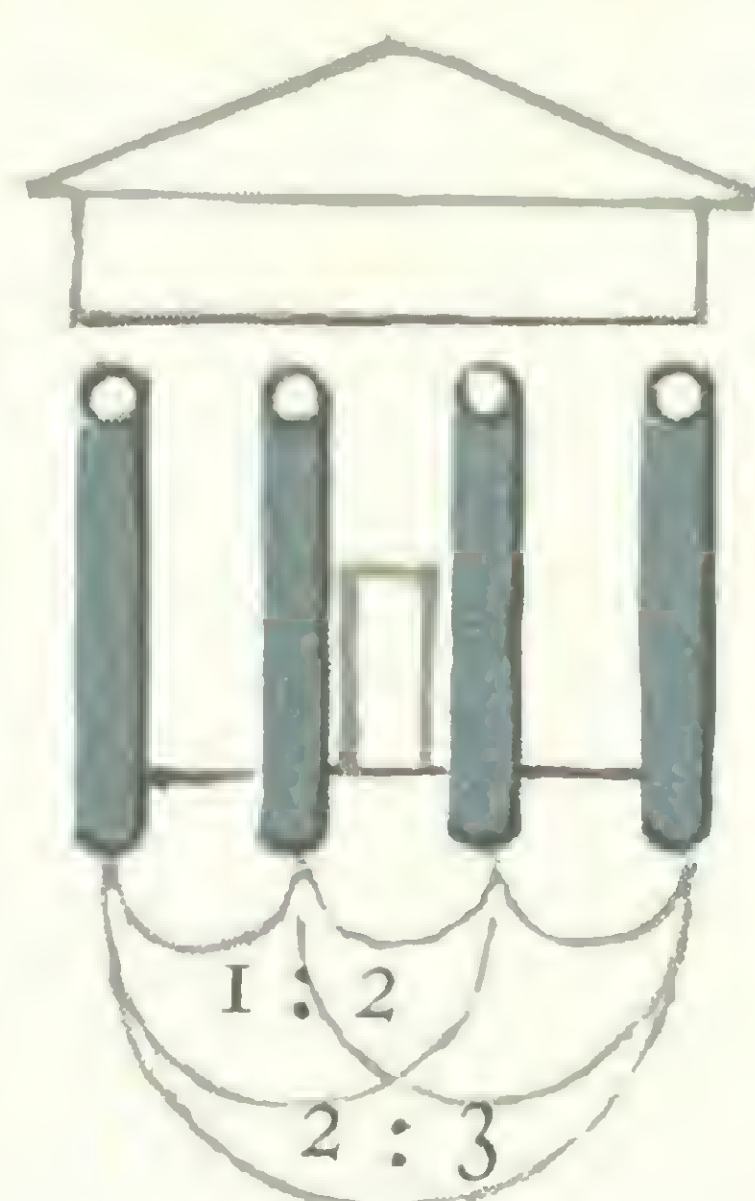
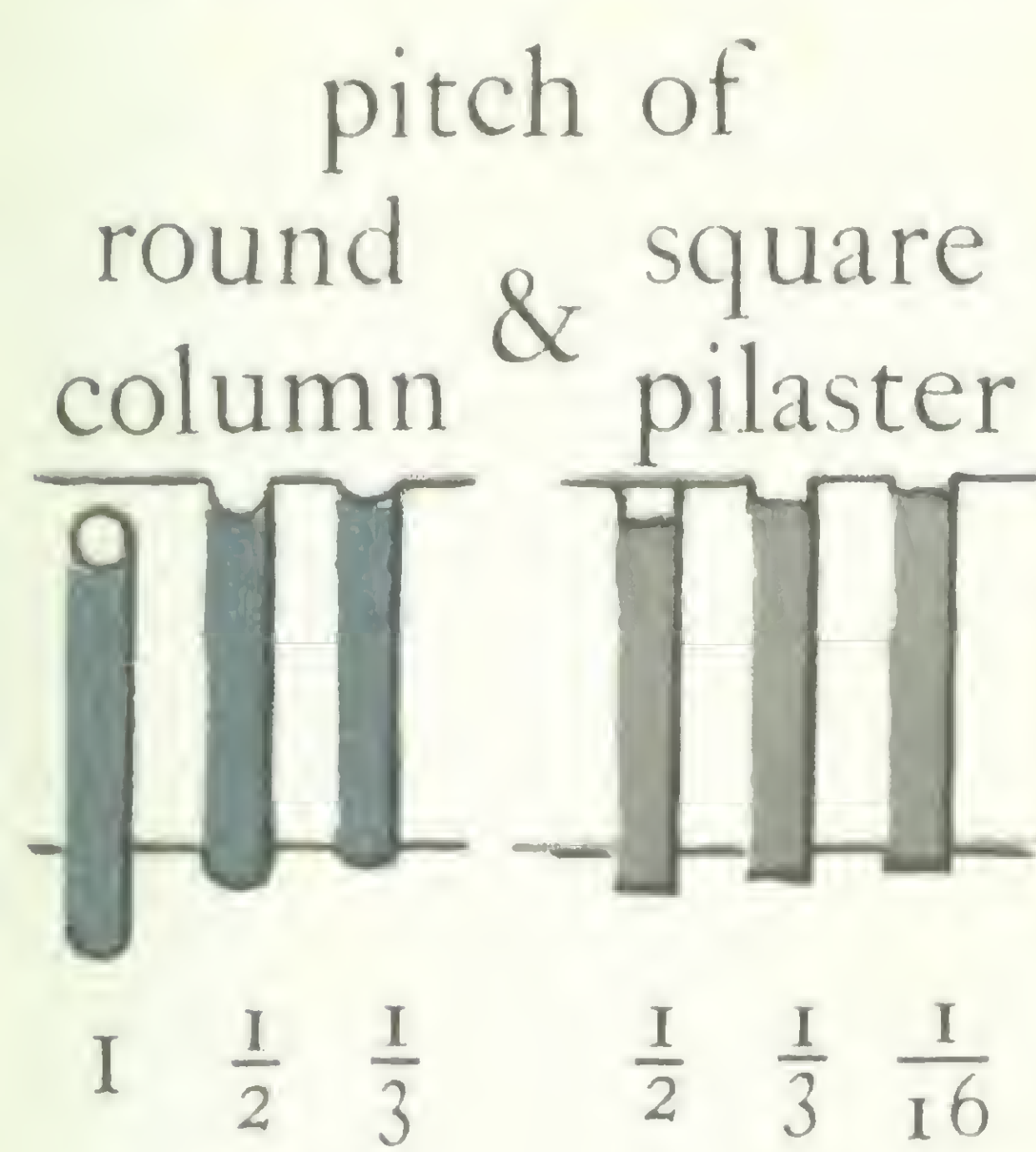
# RENAISSANCE - BAROQUE



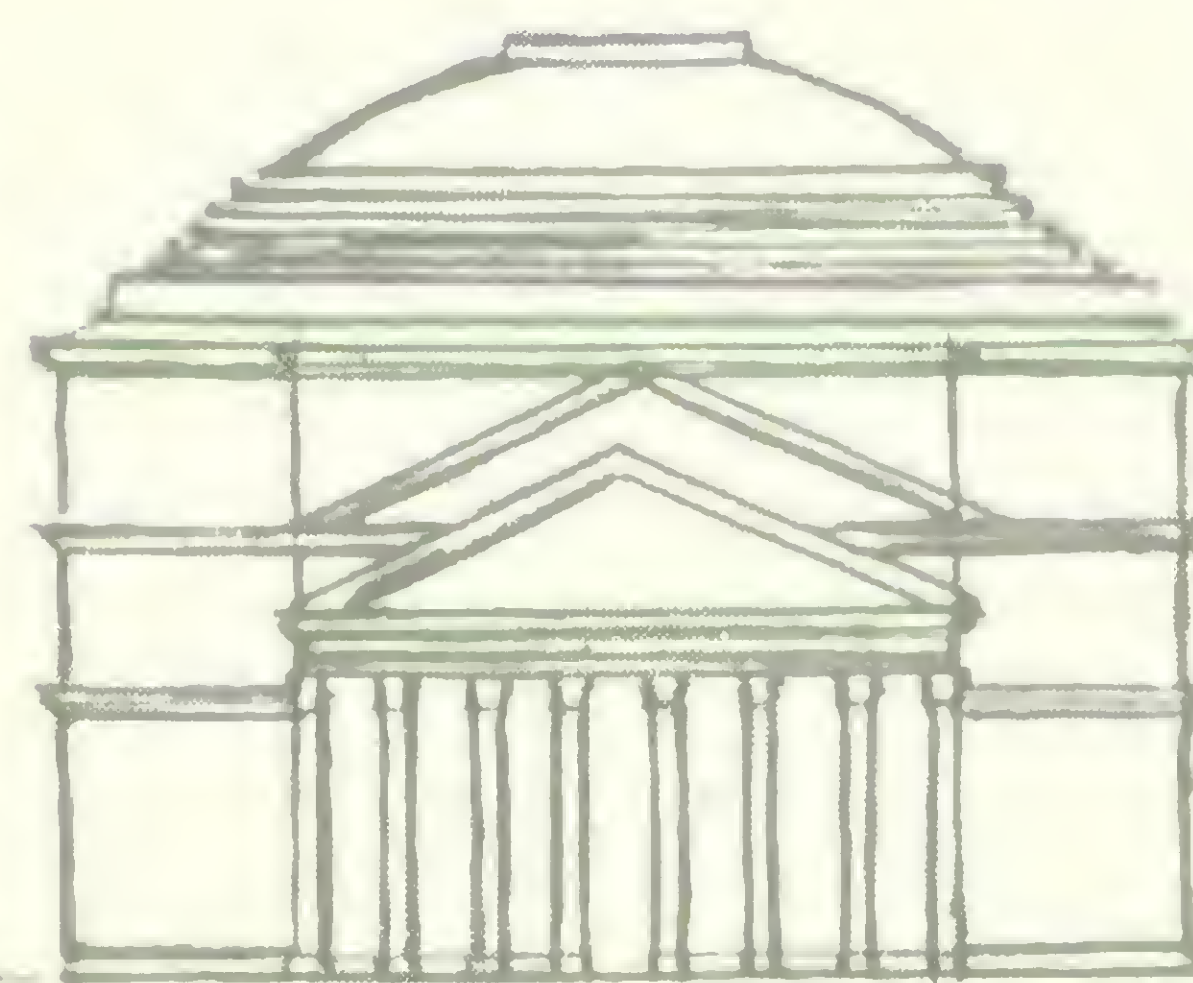
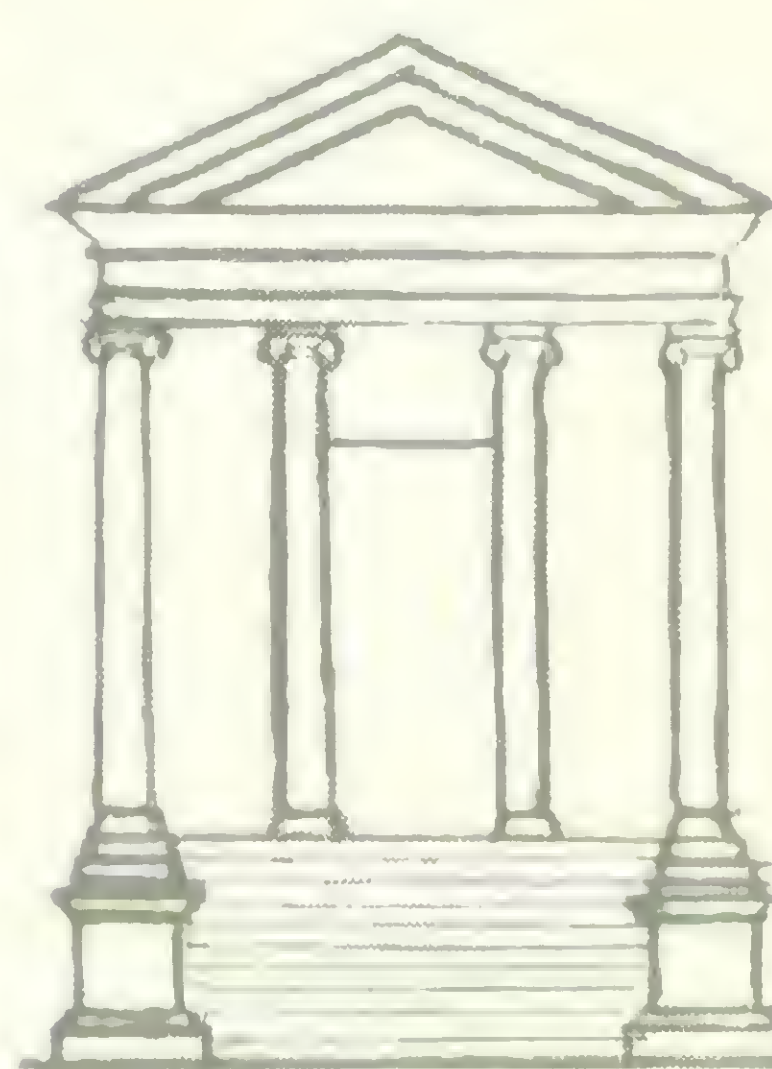
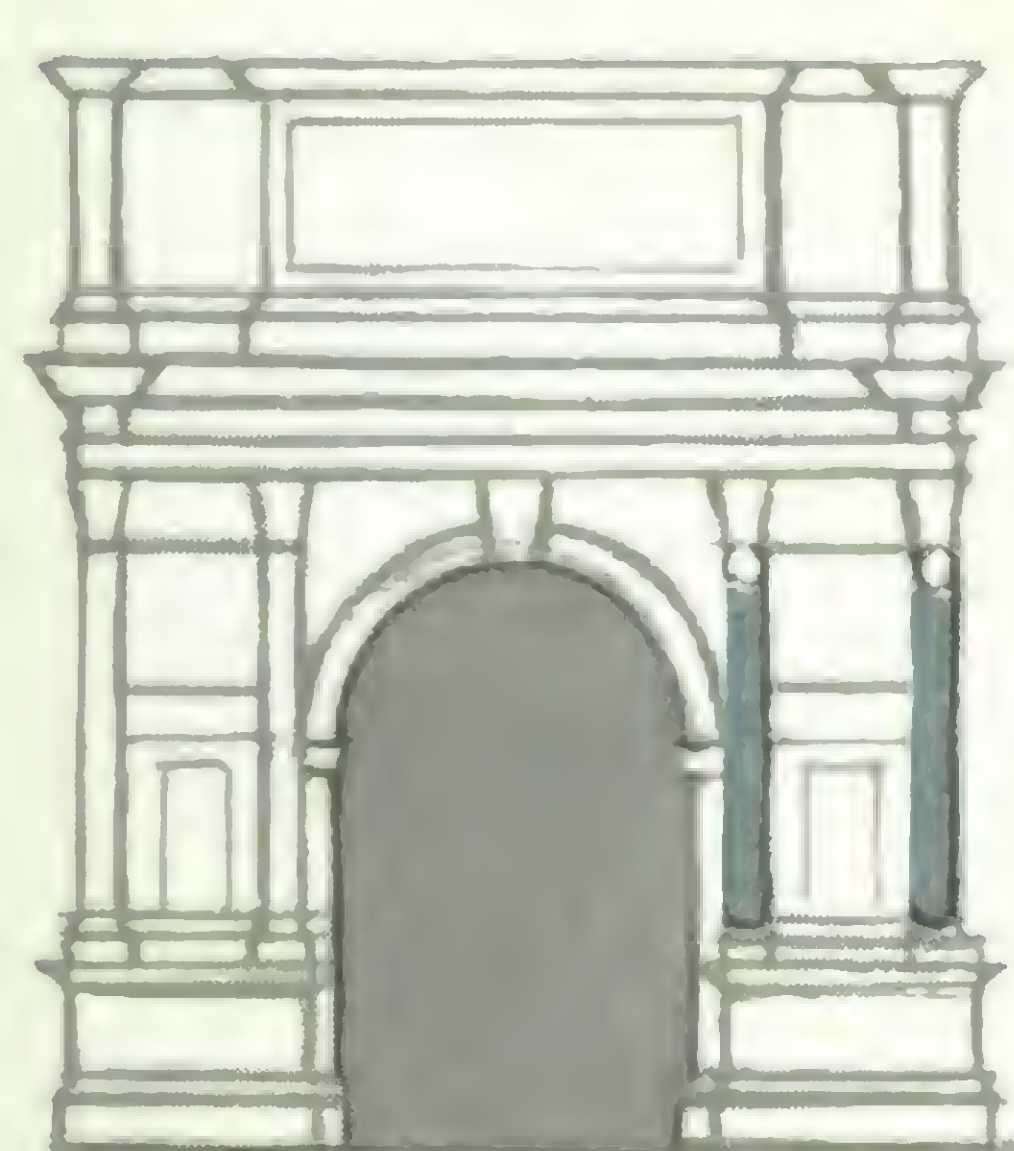
Baptistery, S. Miniato, S. Maria Novella, Florence, c. 1456  
*Alberti (1404-72)*



The Gesù,  
Rome, 1568-75  
*Vignola*  
(1507-73)  
(p. 122)

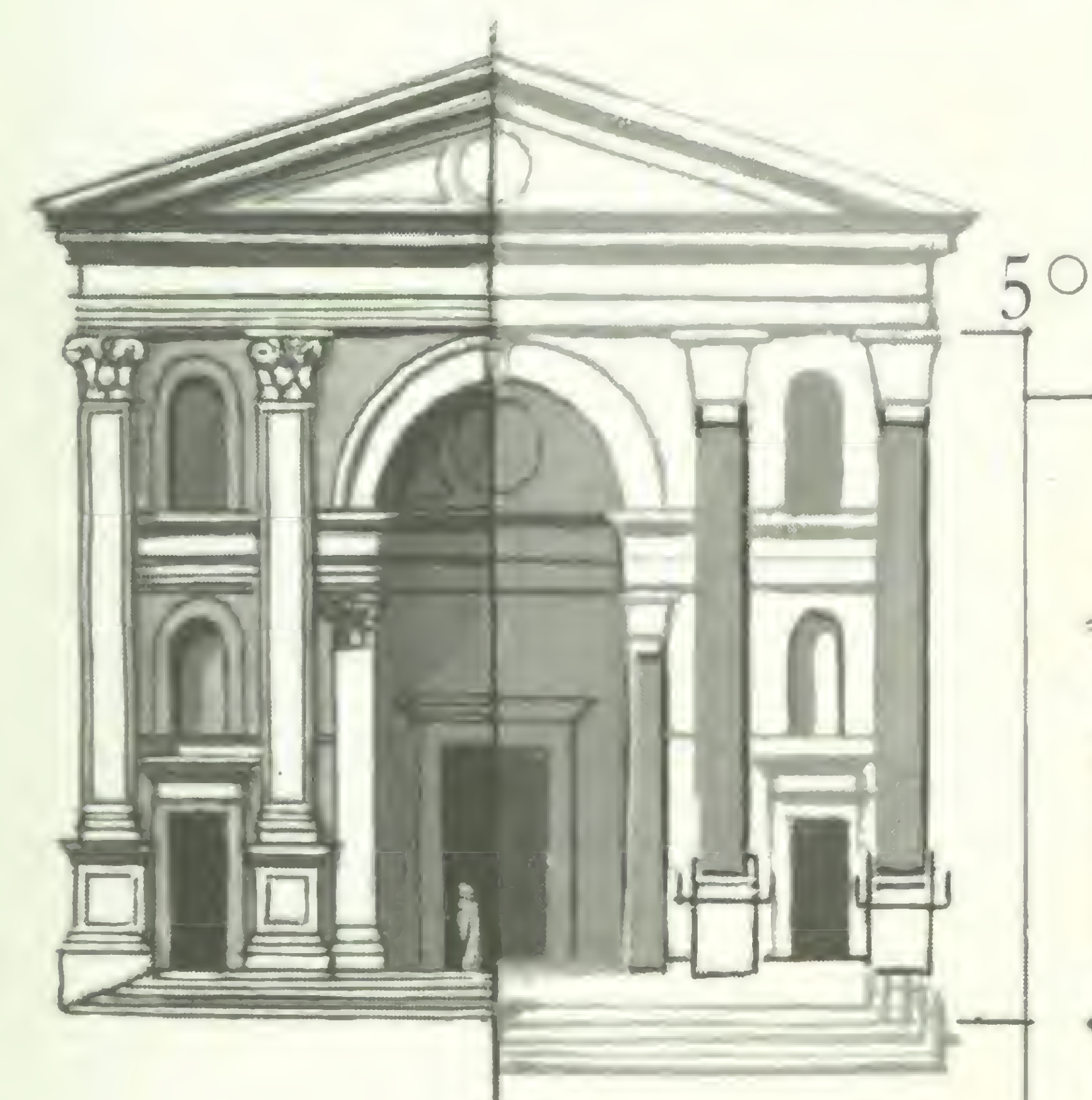


Arrangement & permutations of columns & pilasters to compose a visual 'overture'

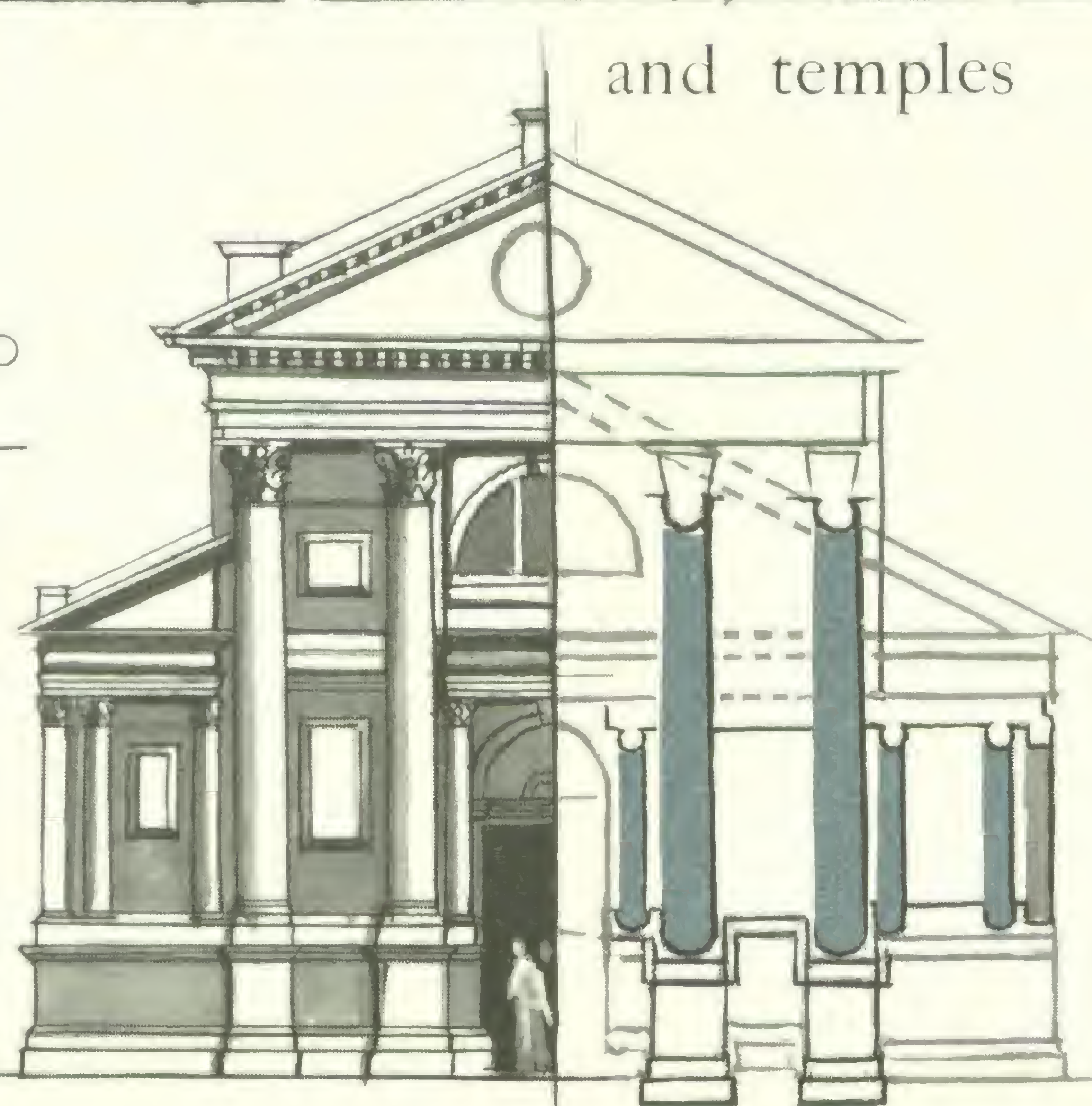


Roman arches

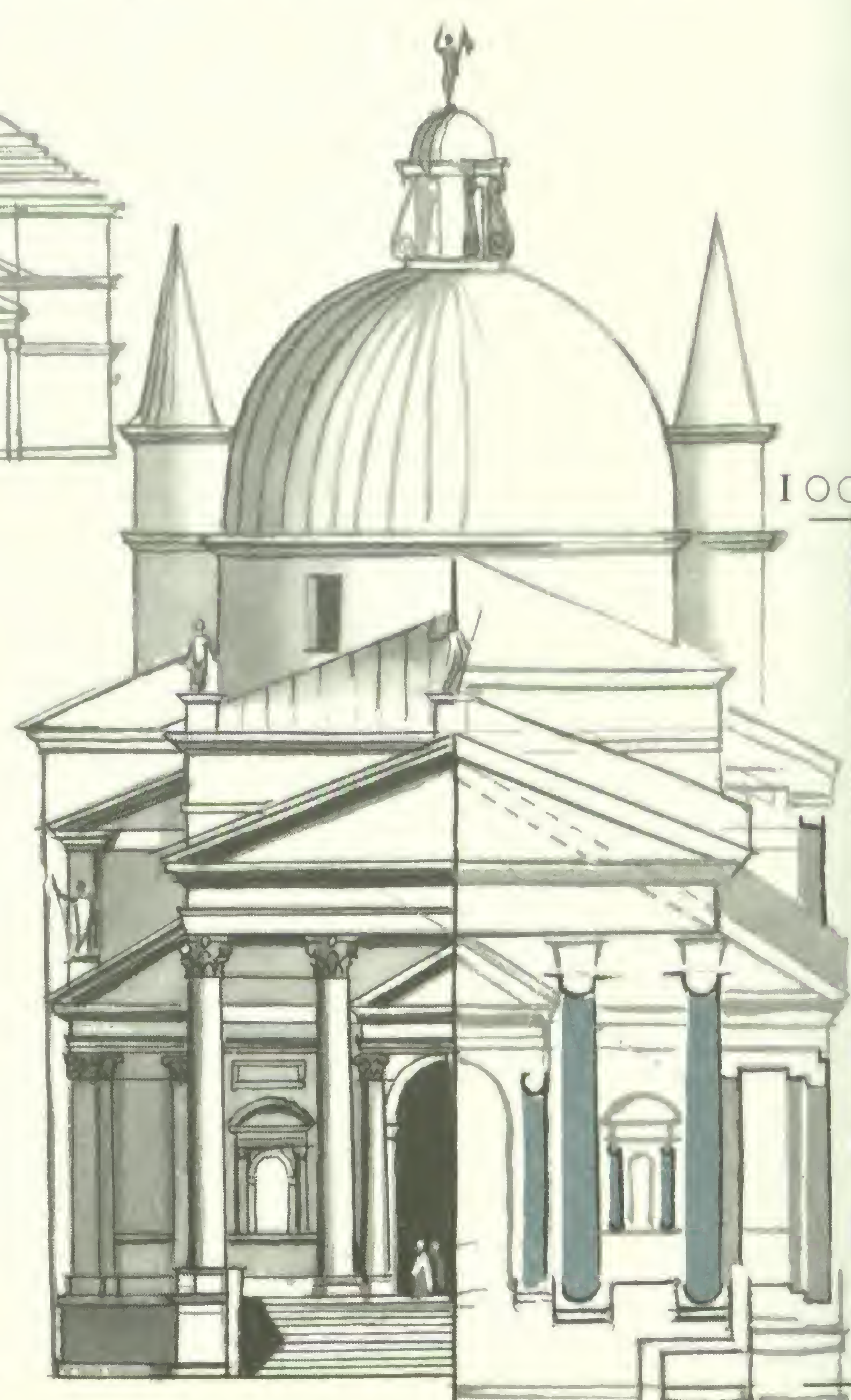
and temples



S. Andrea, Mantua, 1470  
*Alberti (p. 122)*



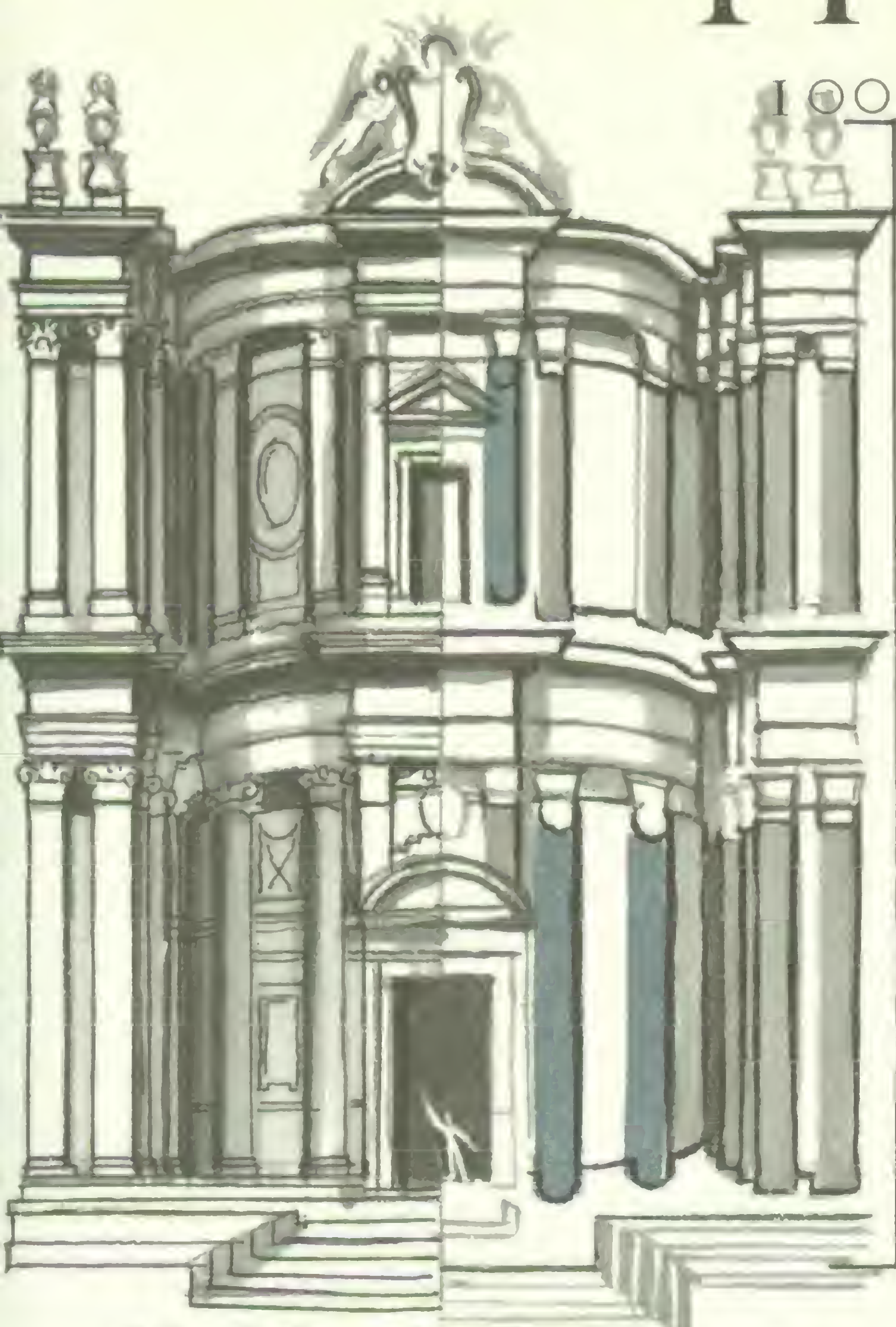
S. Francesco della Vigna, Venice, 1562



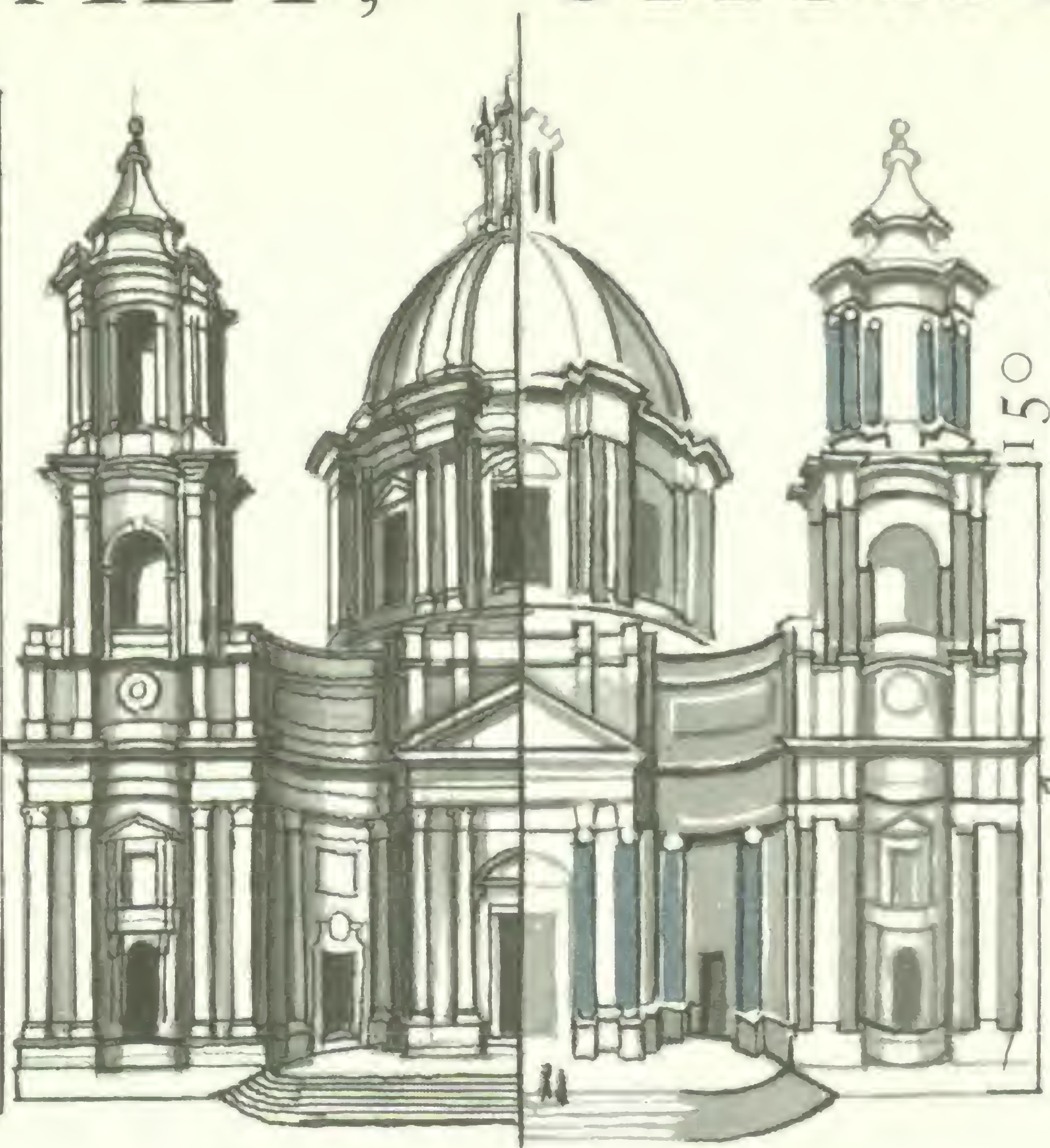
Il Redentore, Venice, 1576-92  
*Andrea Palladio (1508-1580)*



# ITALY, CHURCH FACADES



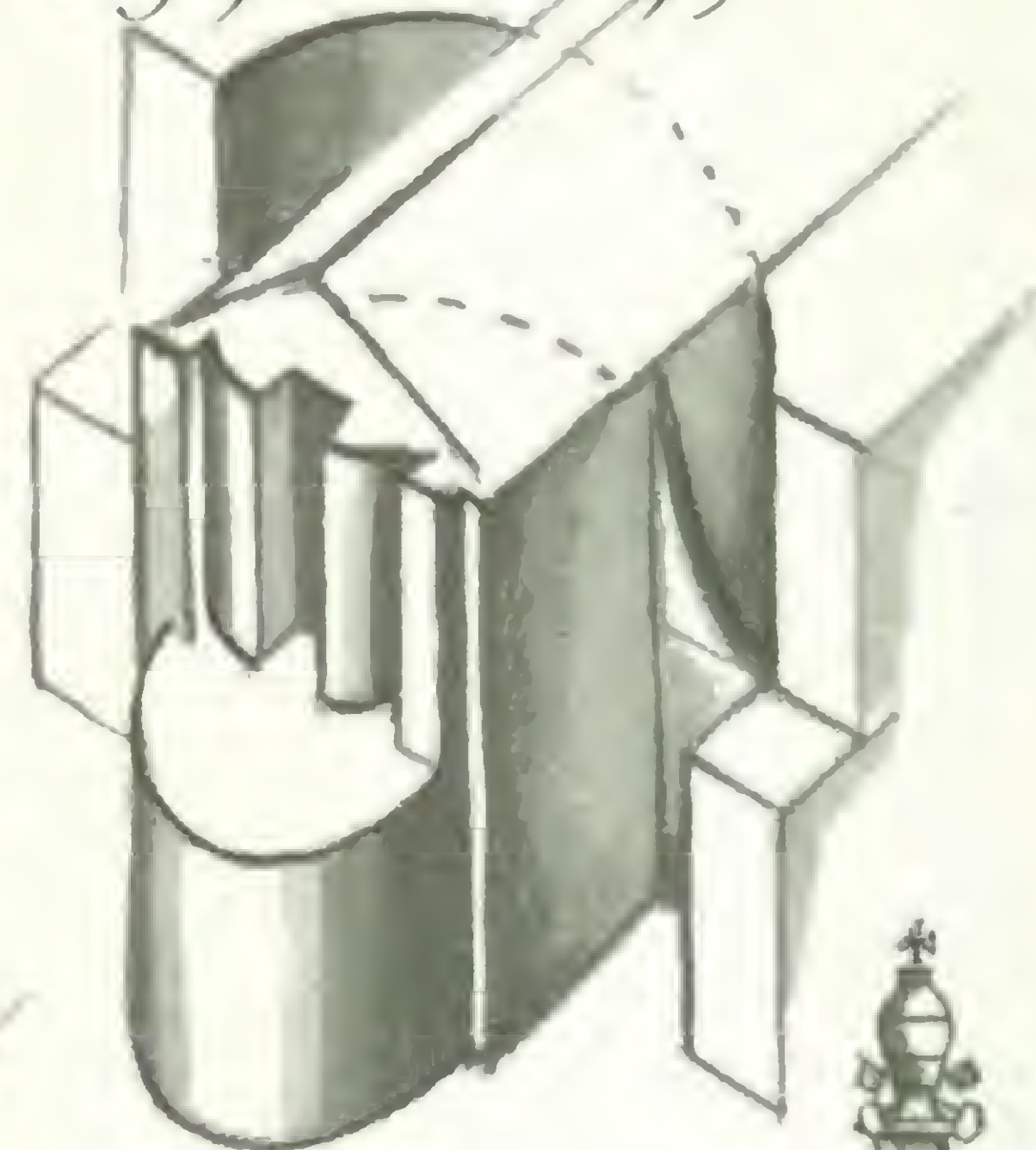
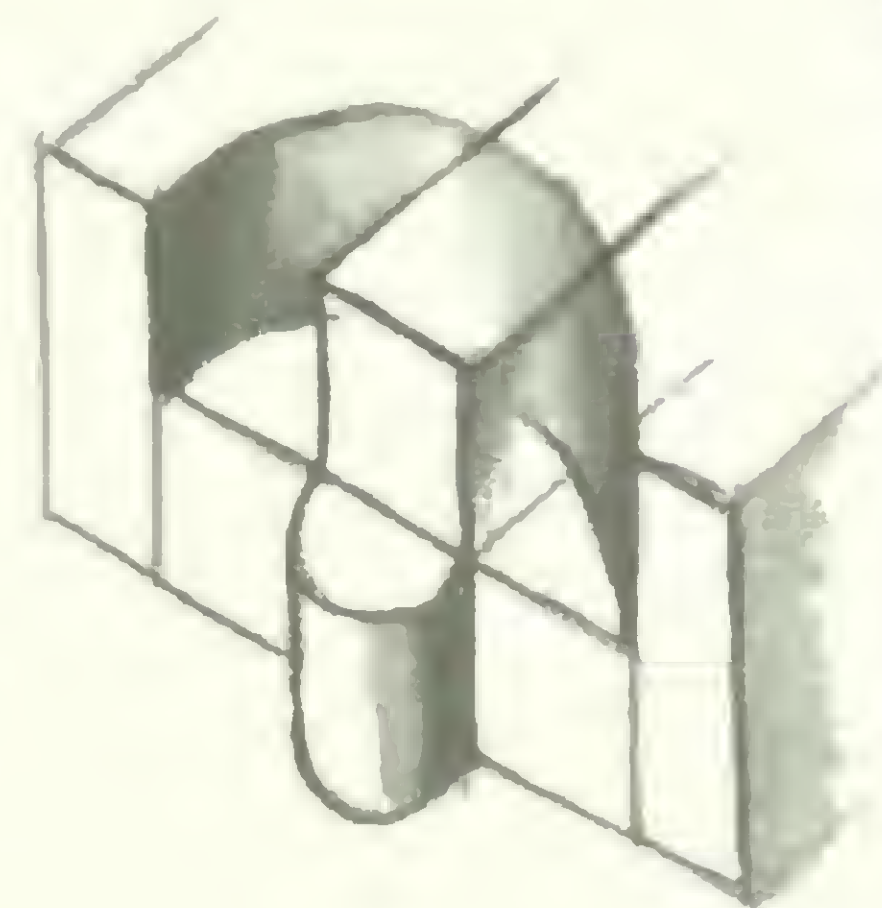
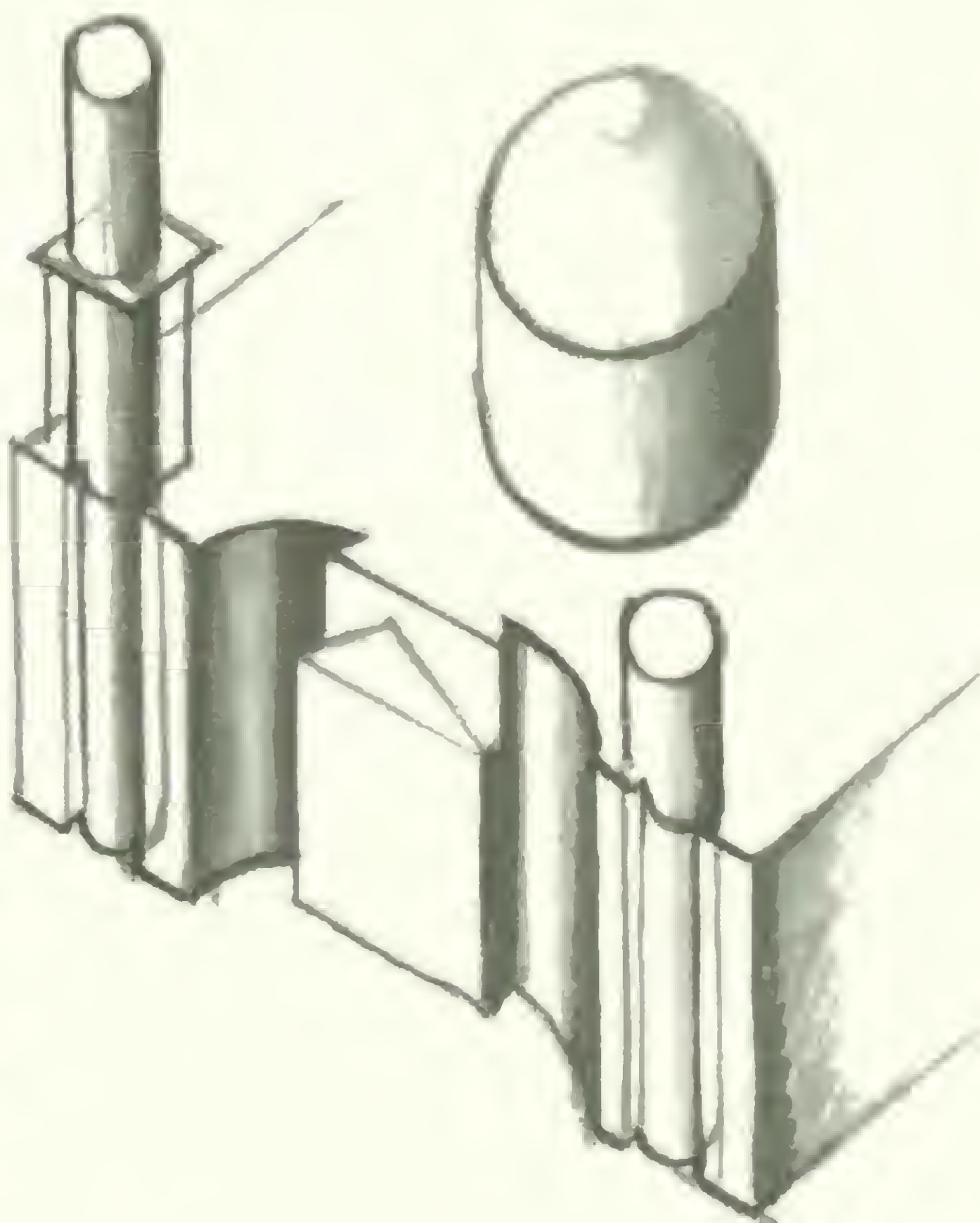
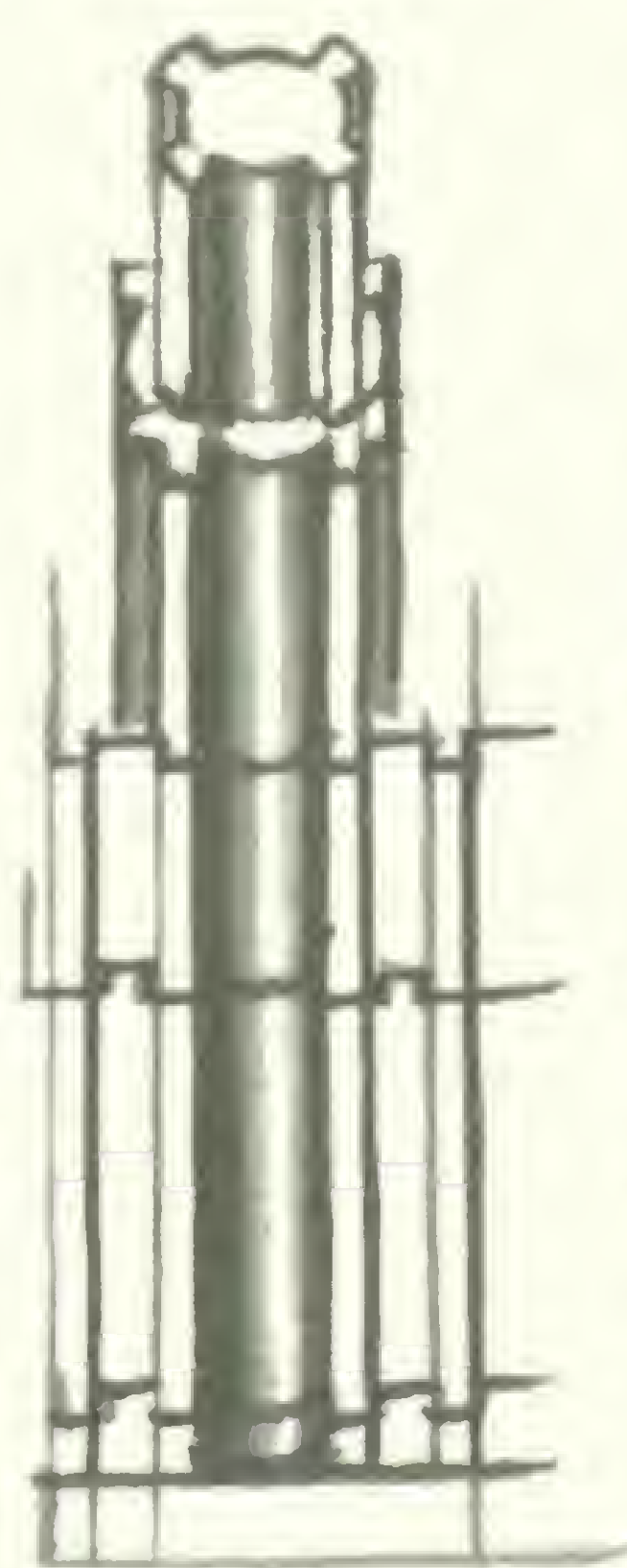
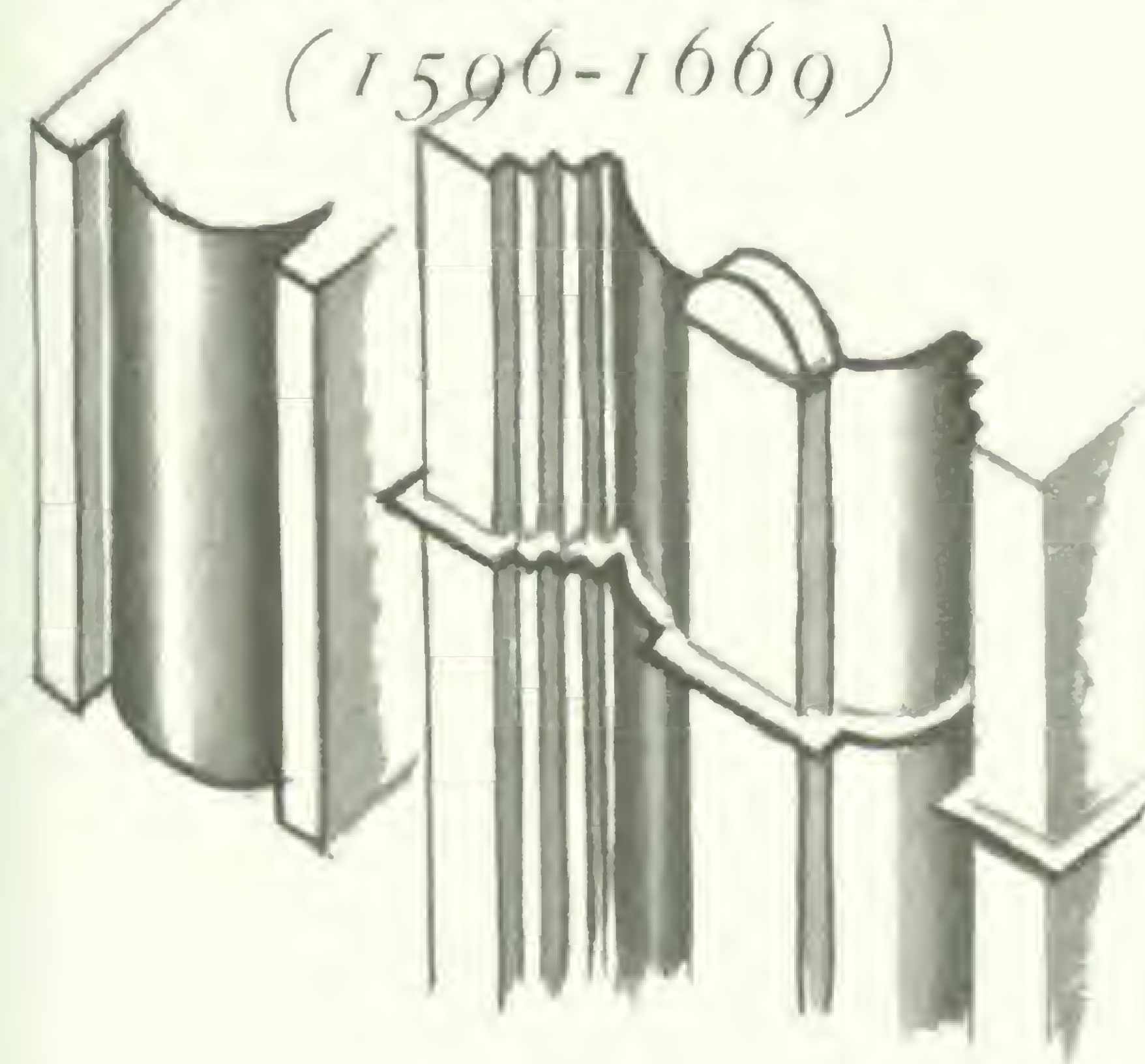
SS. Martina e Luca,  
Rome, 1635-50  
*Pietro da Cortona*  
(1596-1669)



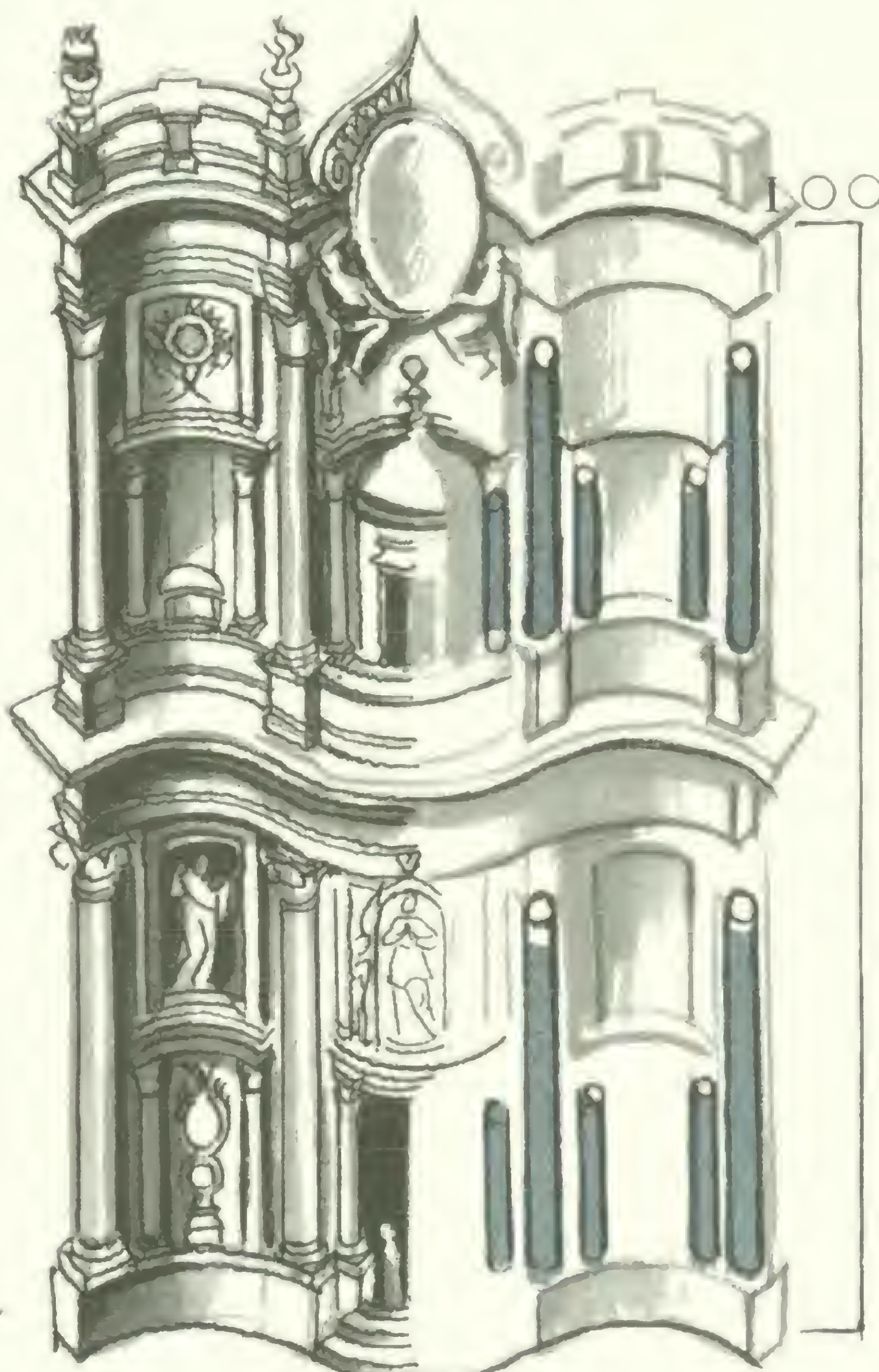
S. Agnese in Piazza Navona,  
Rome, 1653-55  
*Francesco Borromini* (1599-1667)



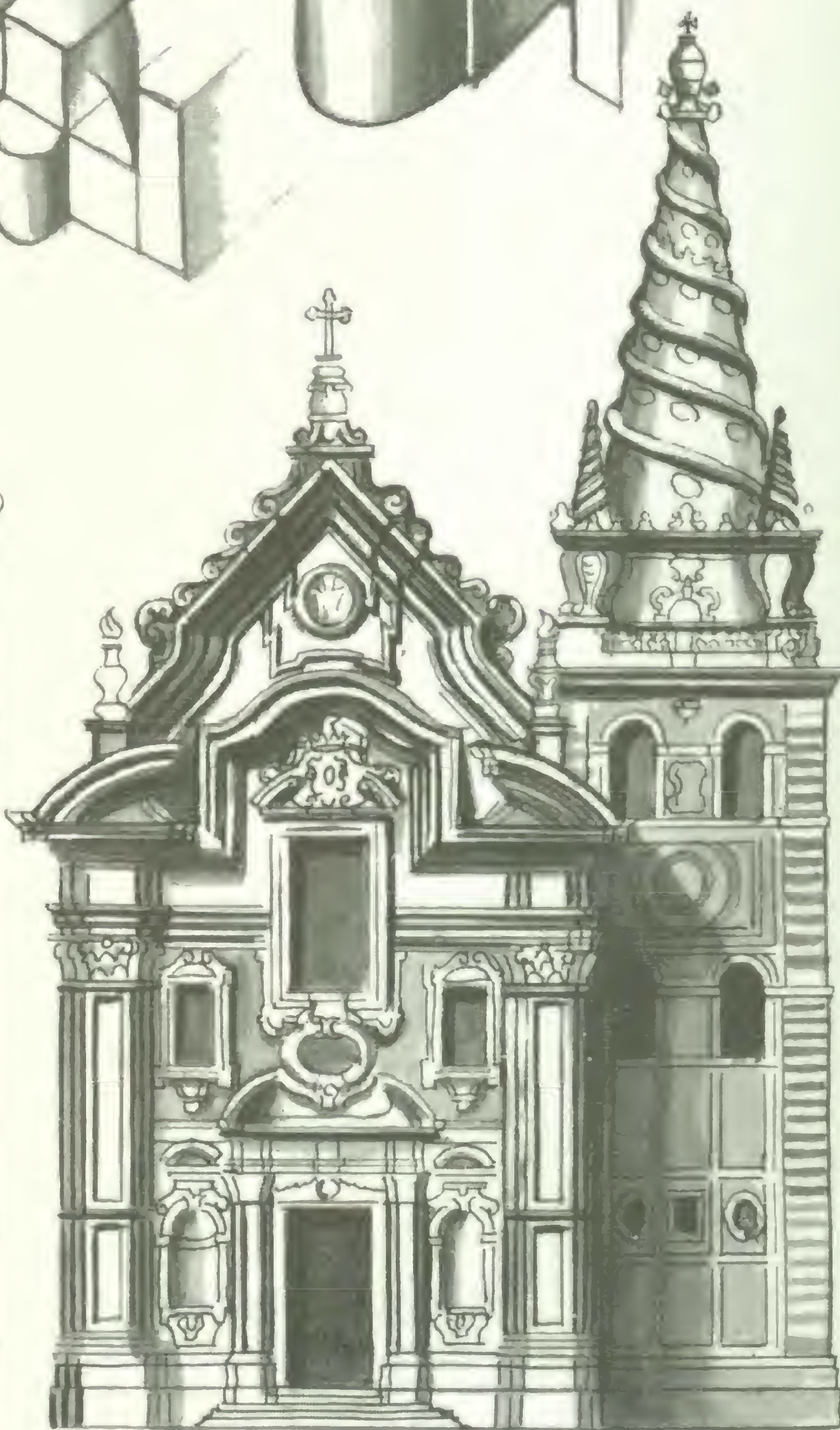
S. Maria della Pace,  
Rome, 1656-57  
*Pietro da Cortona*  
(1596-1669)



S. Susanna, Rome, 1597-1603  
*Carlo Maderna* (1556-1629)



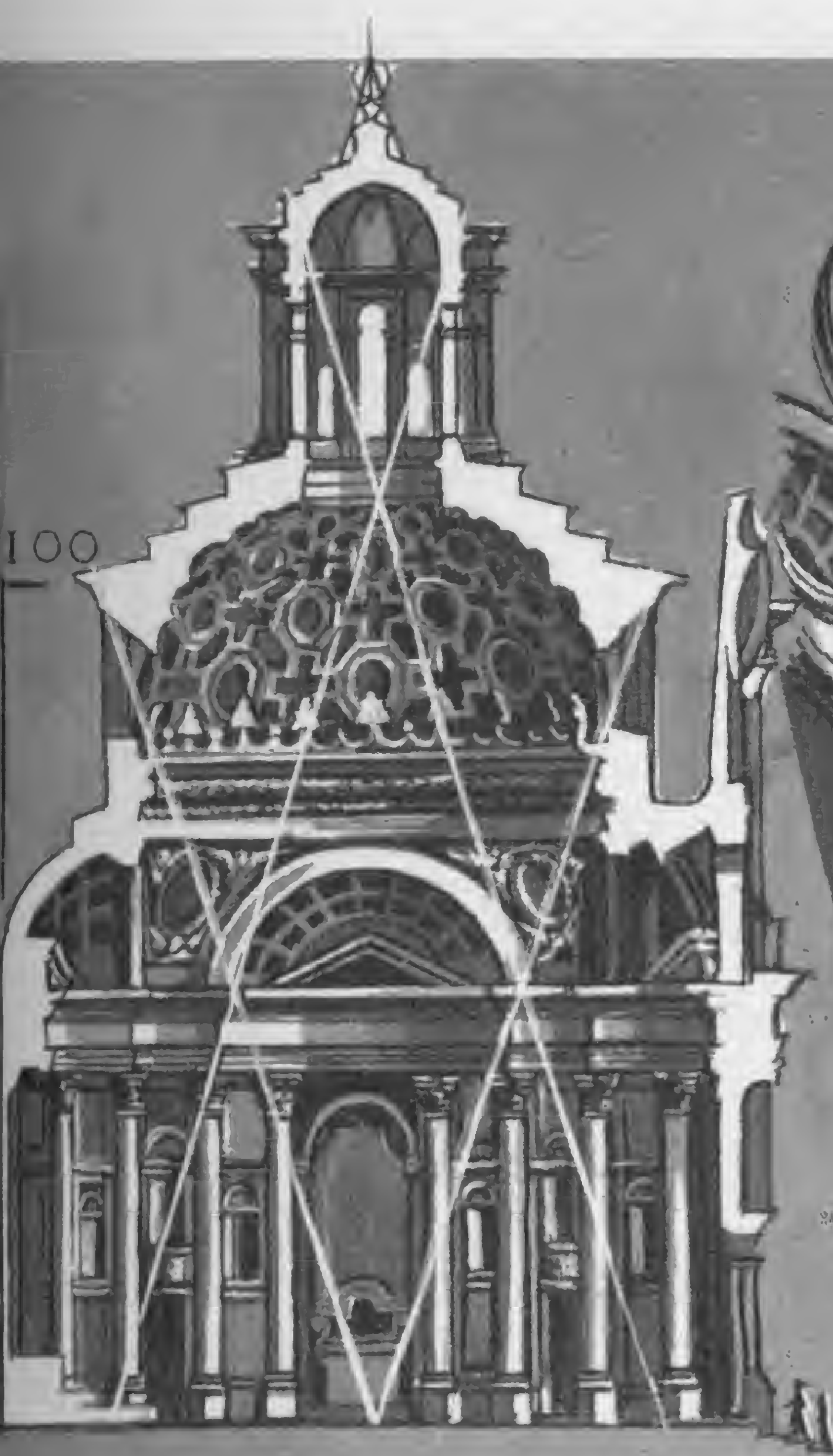
S. Carlo, Rome, 1665-7  
*Borromini* (p. 123)



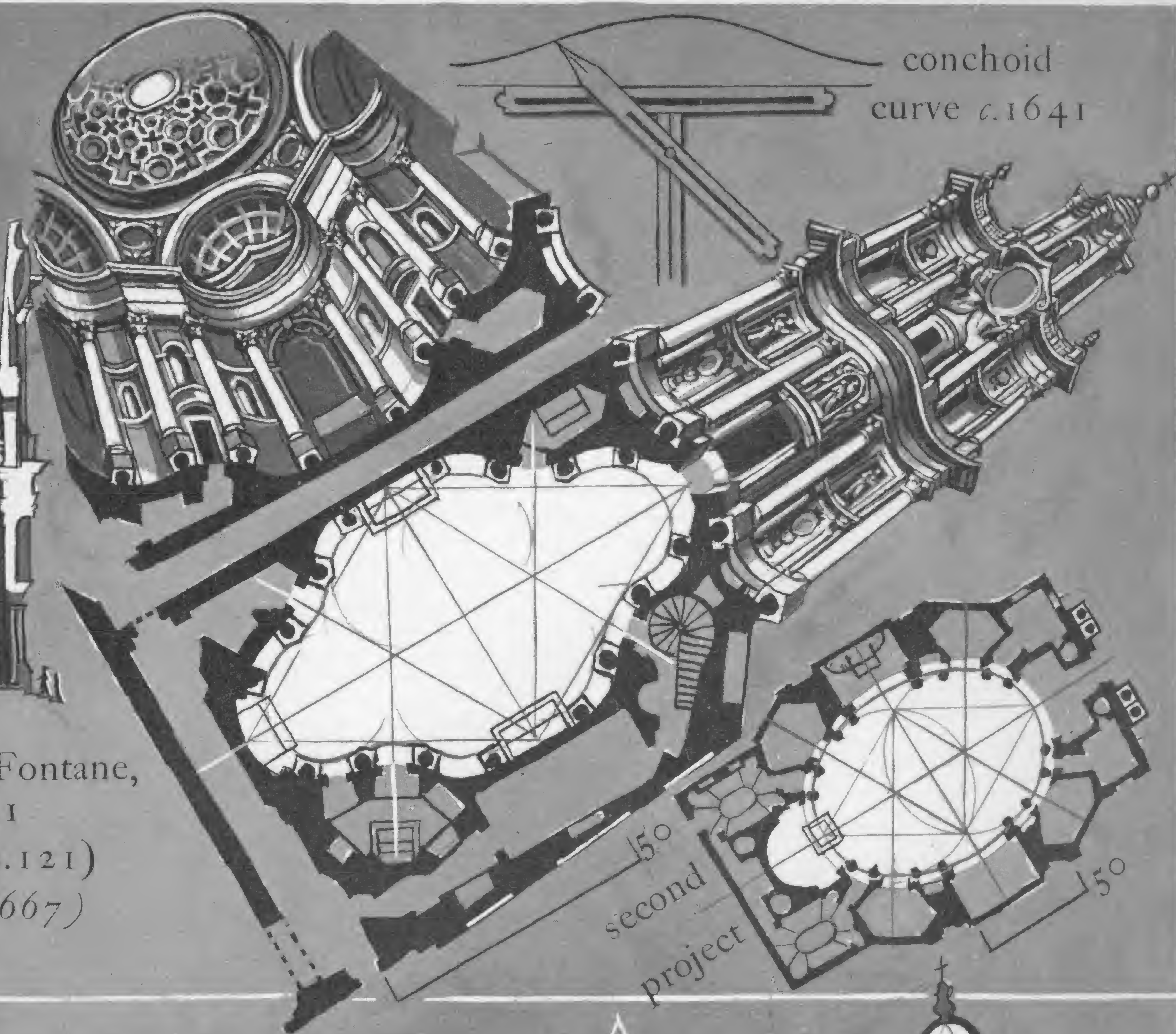
S. Gregorio, Messina, 1660  
*Guarini* (1624-1683)



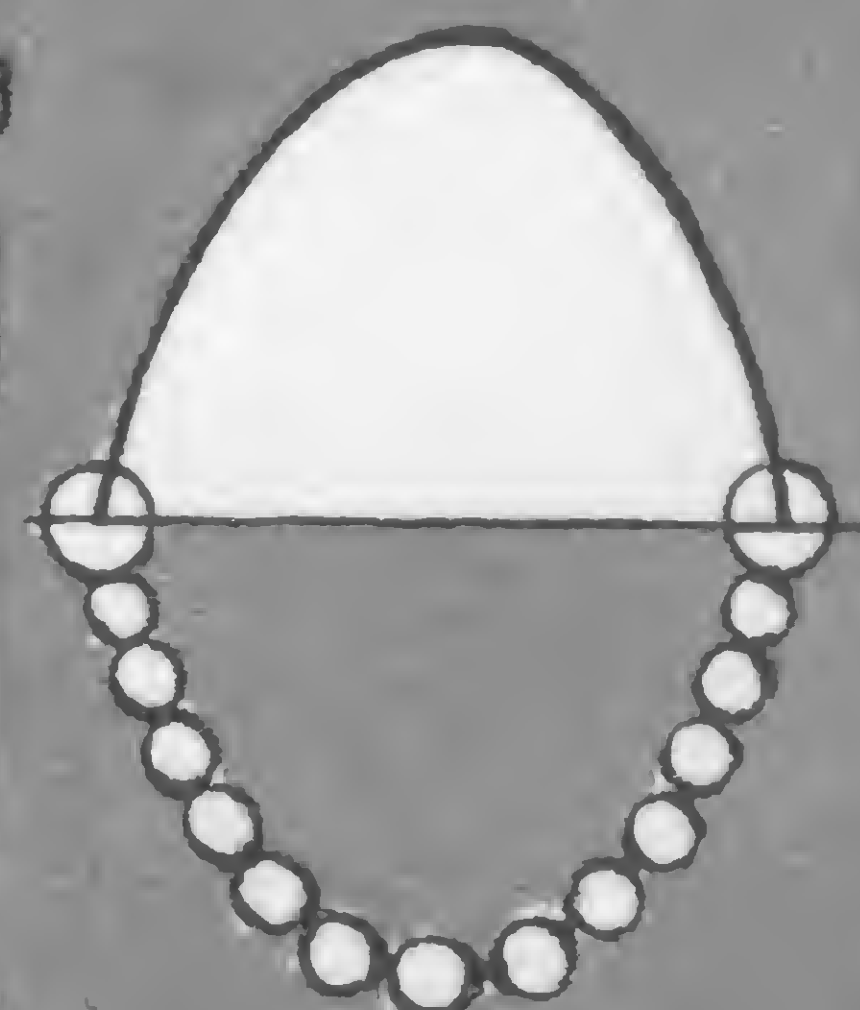
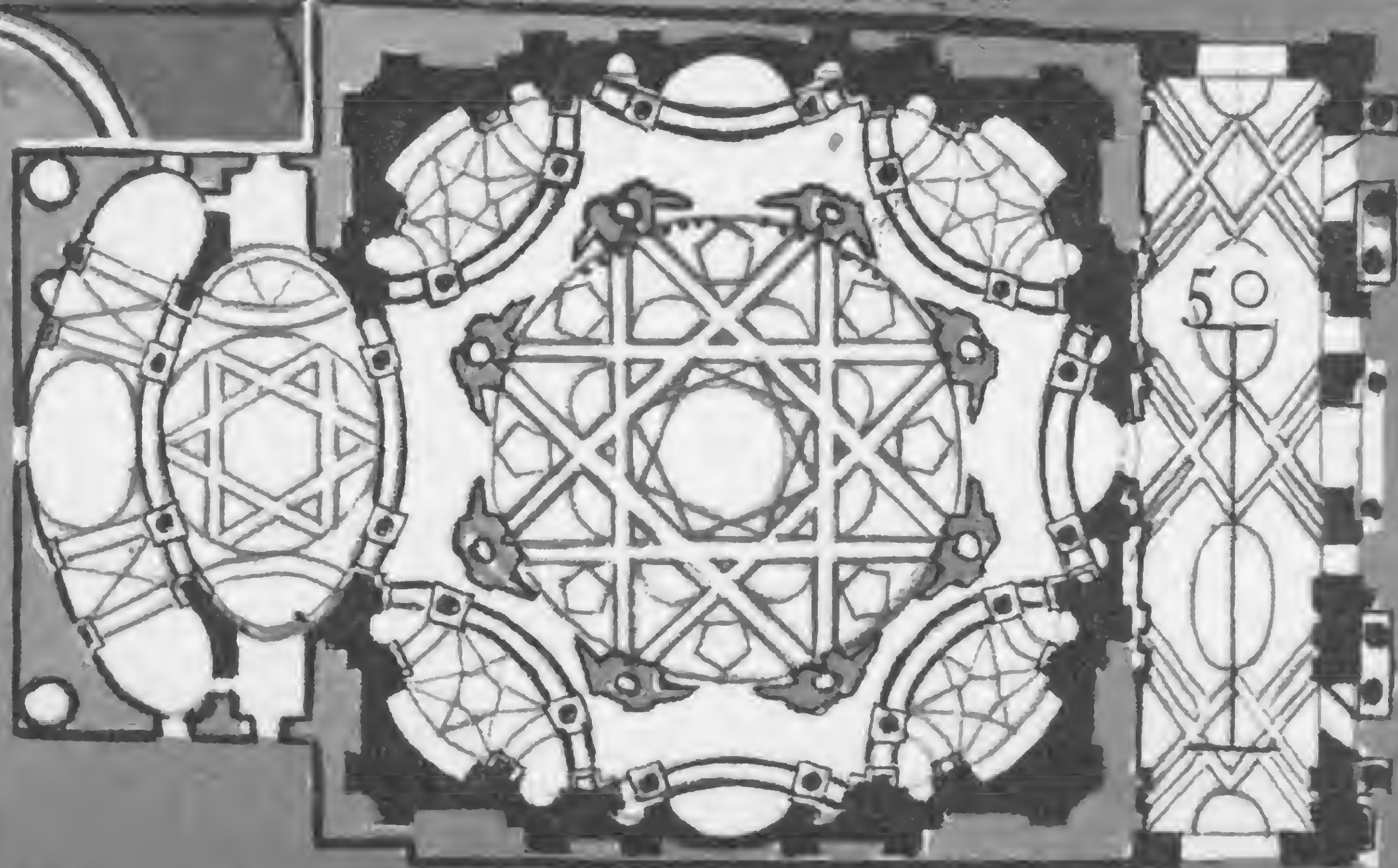
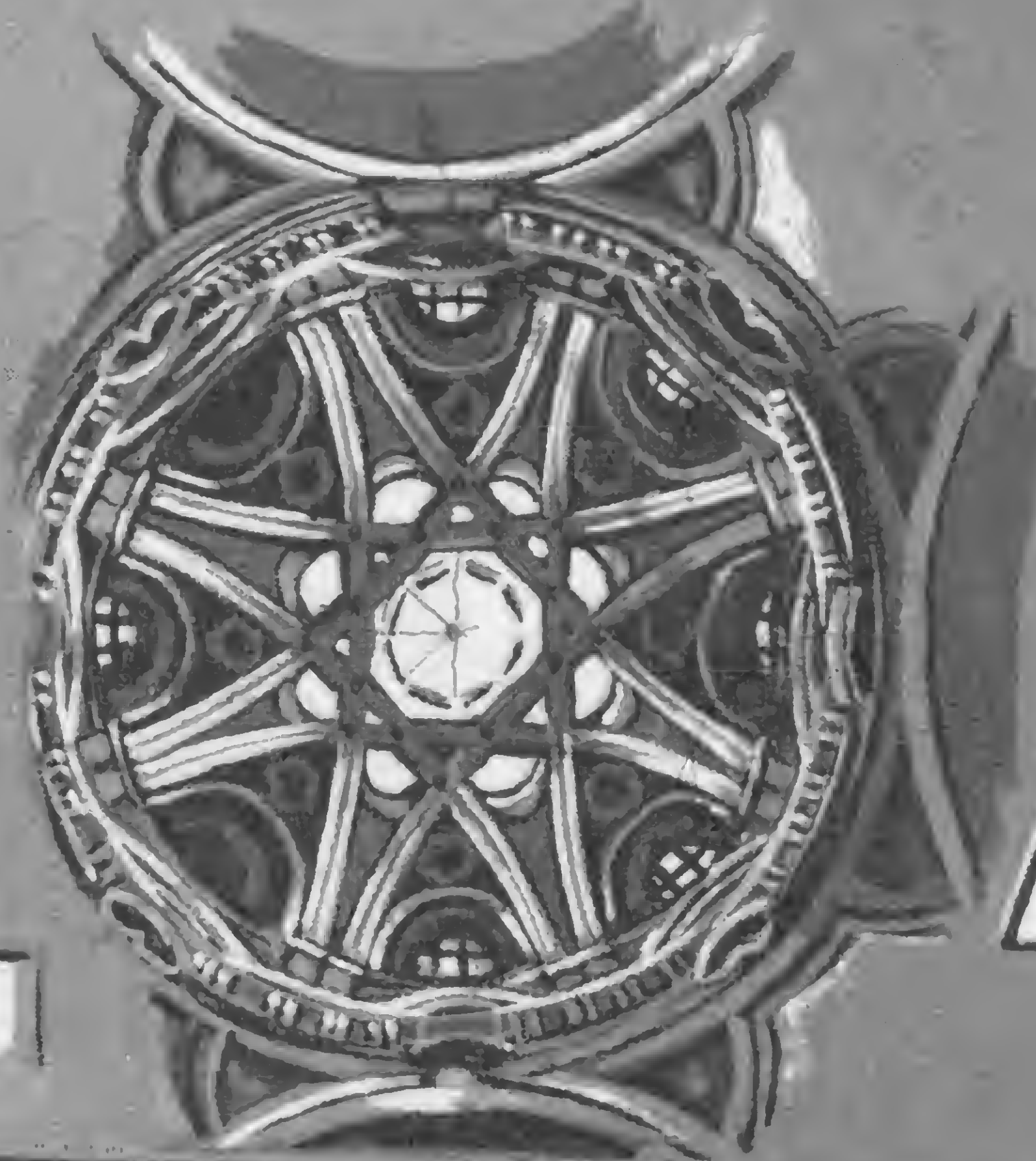
# ITALY, CHURCHES



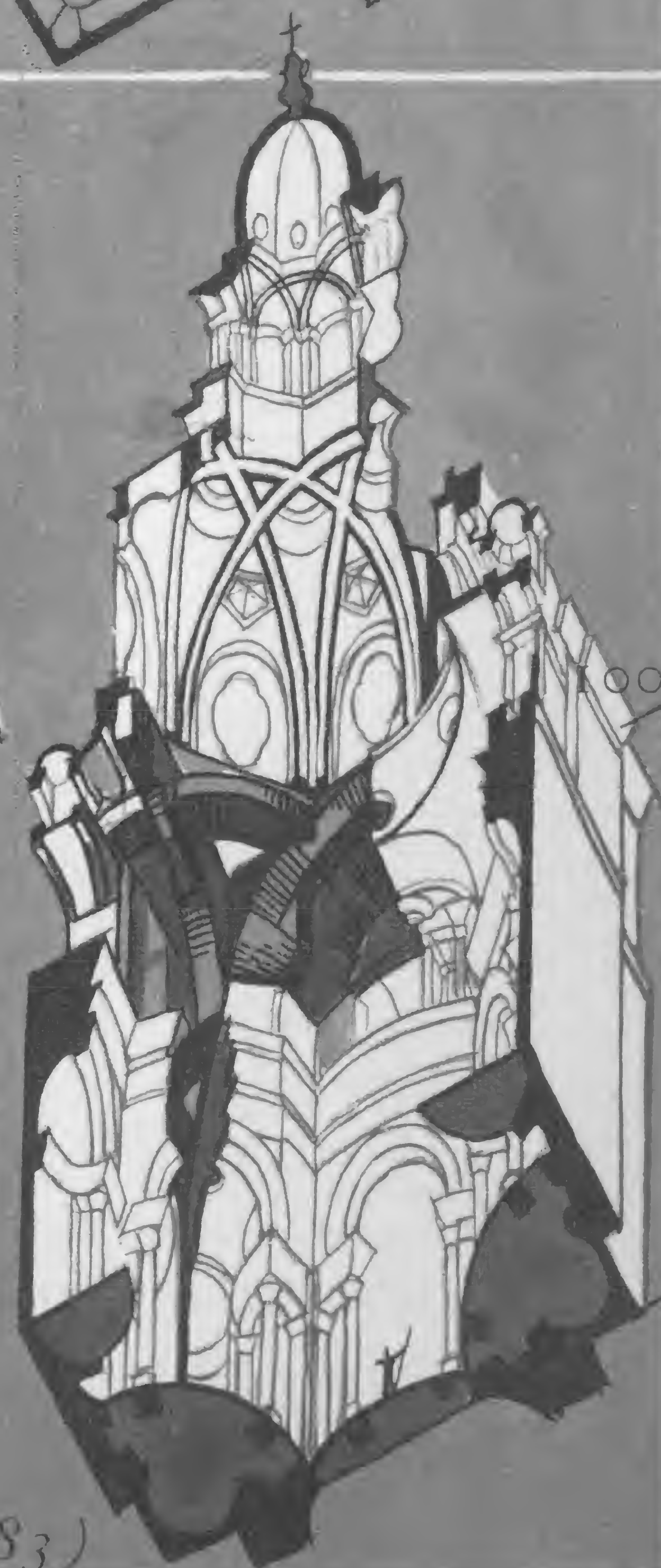
S. Carlo alle Quattro Fontane,  
Rome, 1638-41  
(Façade 1662-67, p.121)  
*Borromini (1599-1667)*



Façade from Dell'  
Architettura Civile



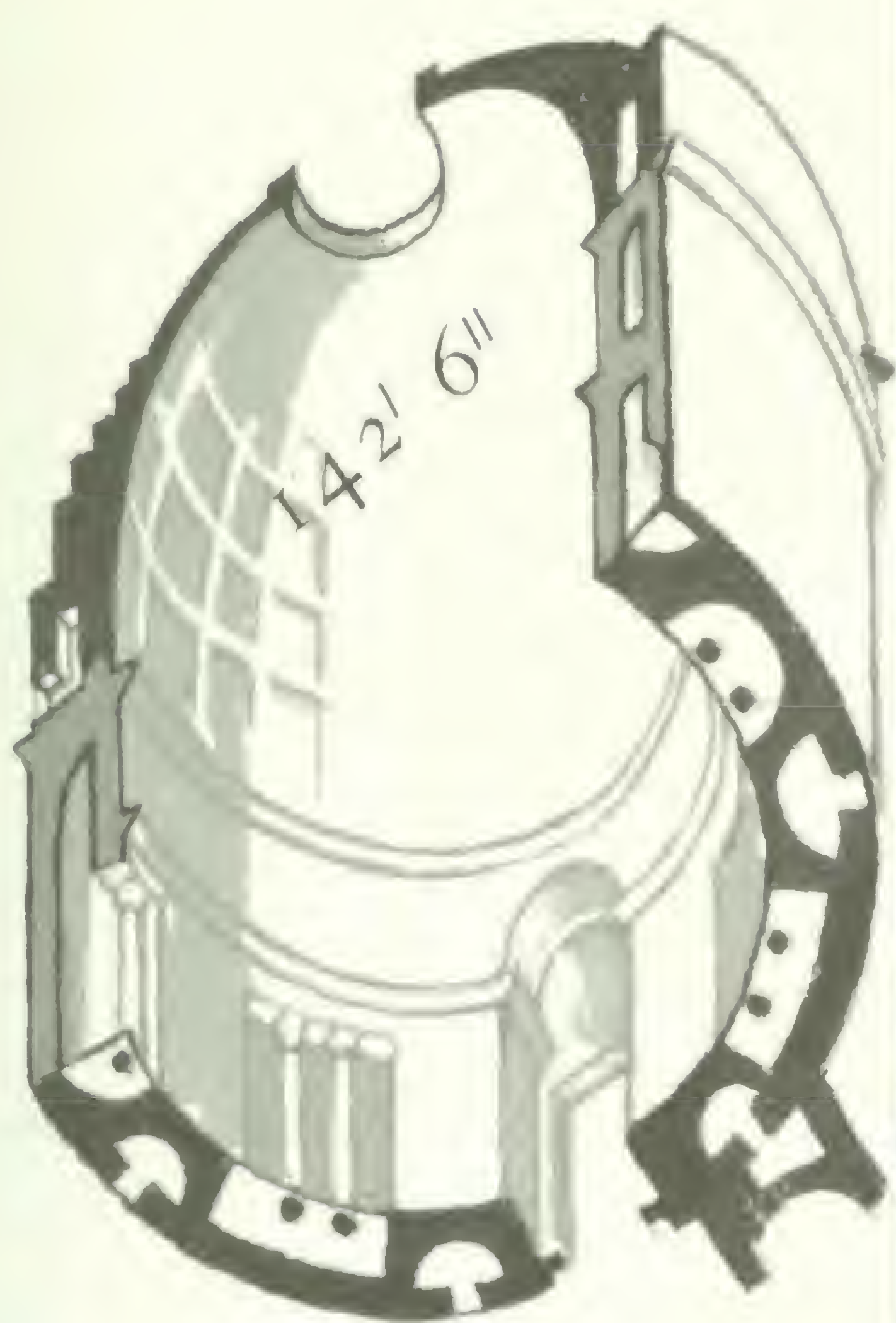
catenary  
curve



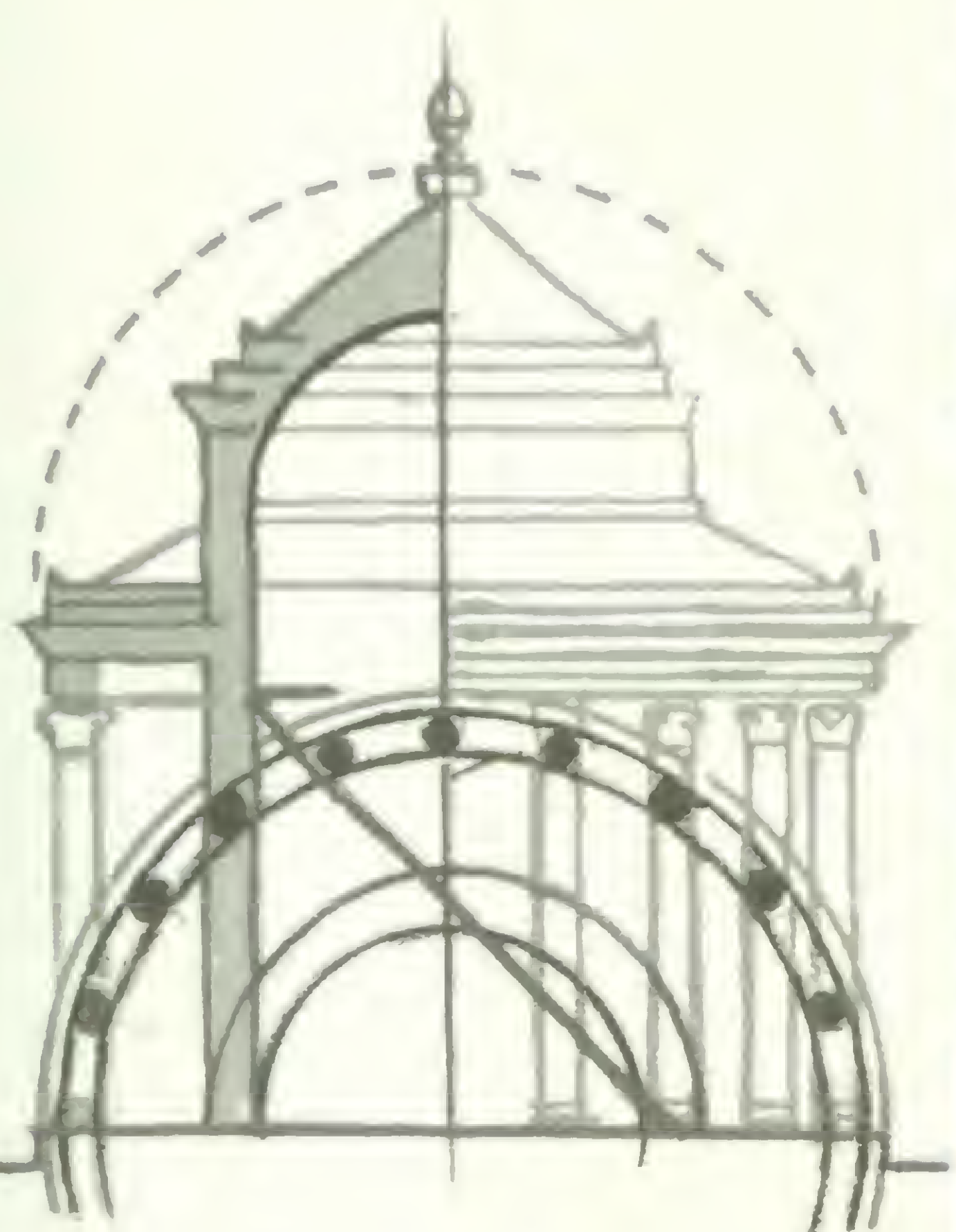
S. Lorenzo, Turin, 1668-87 *Guarini (1624-83)*



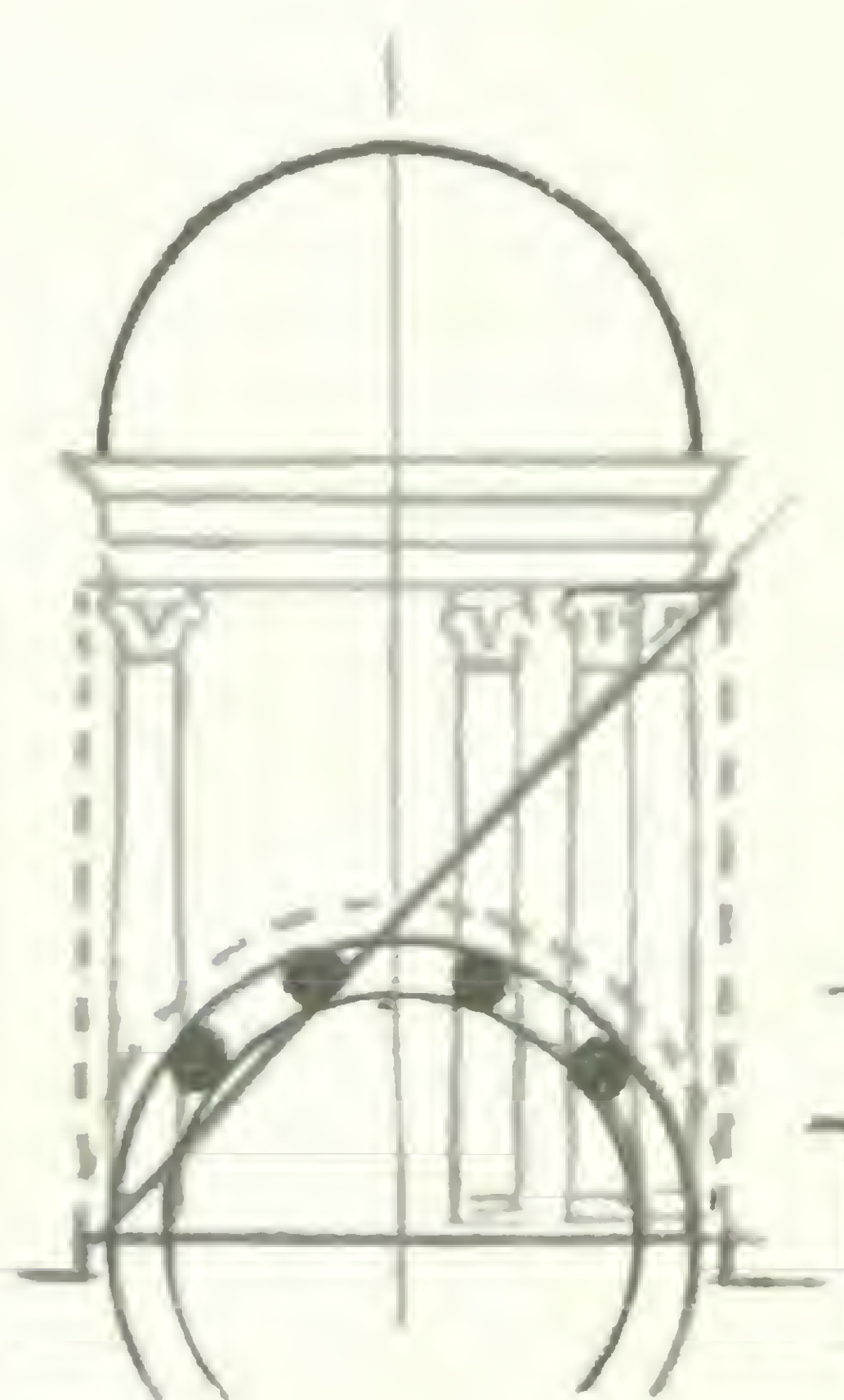
# RENAISSANCE - BAROQUE



The Pantheon,  
Rome, A.D. 120-124



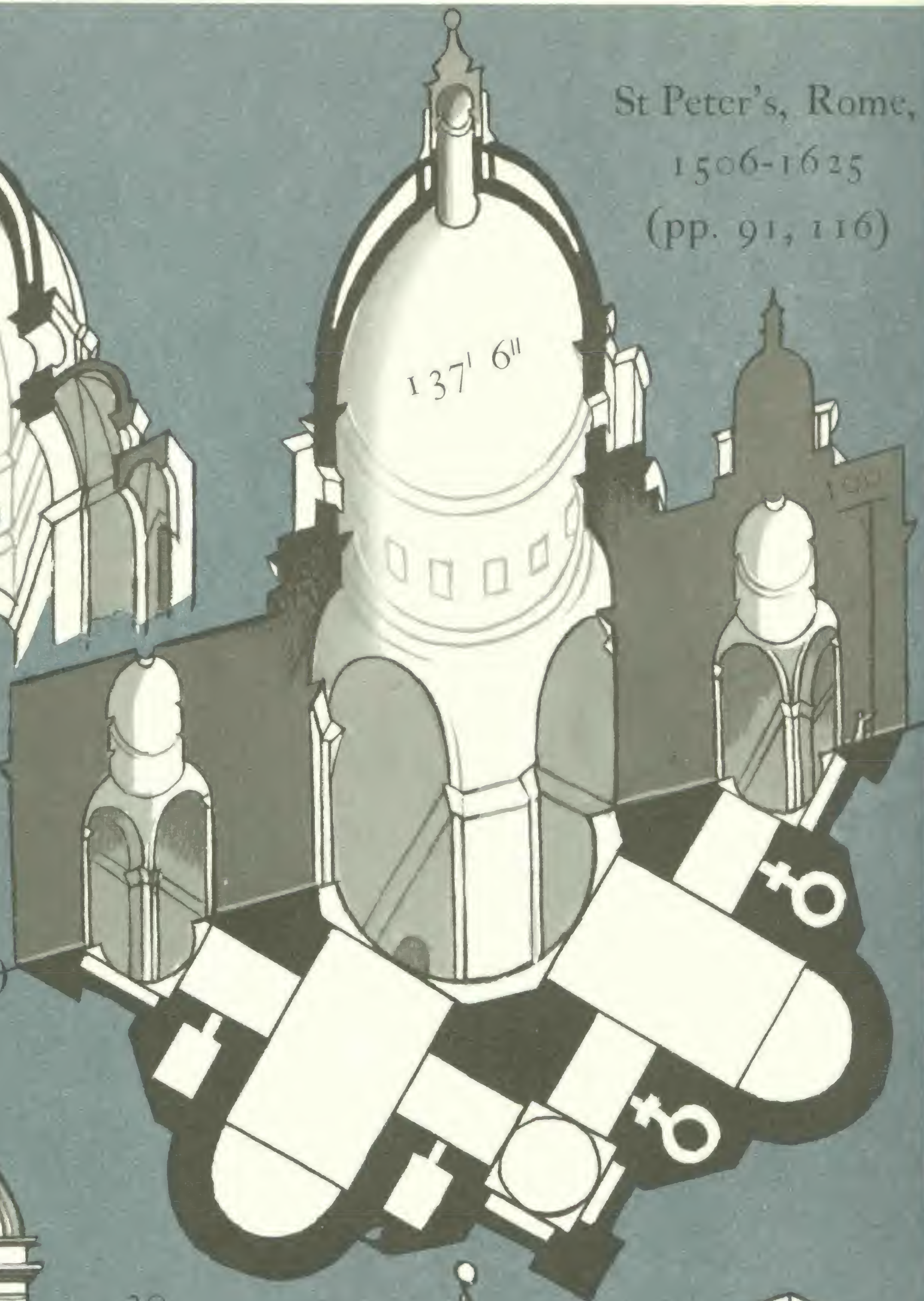
Circular temples,  
Vitruvius (IV, 9)



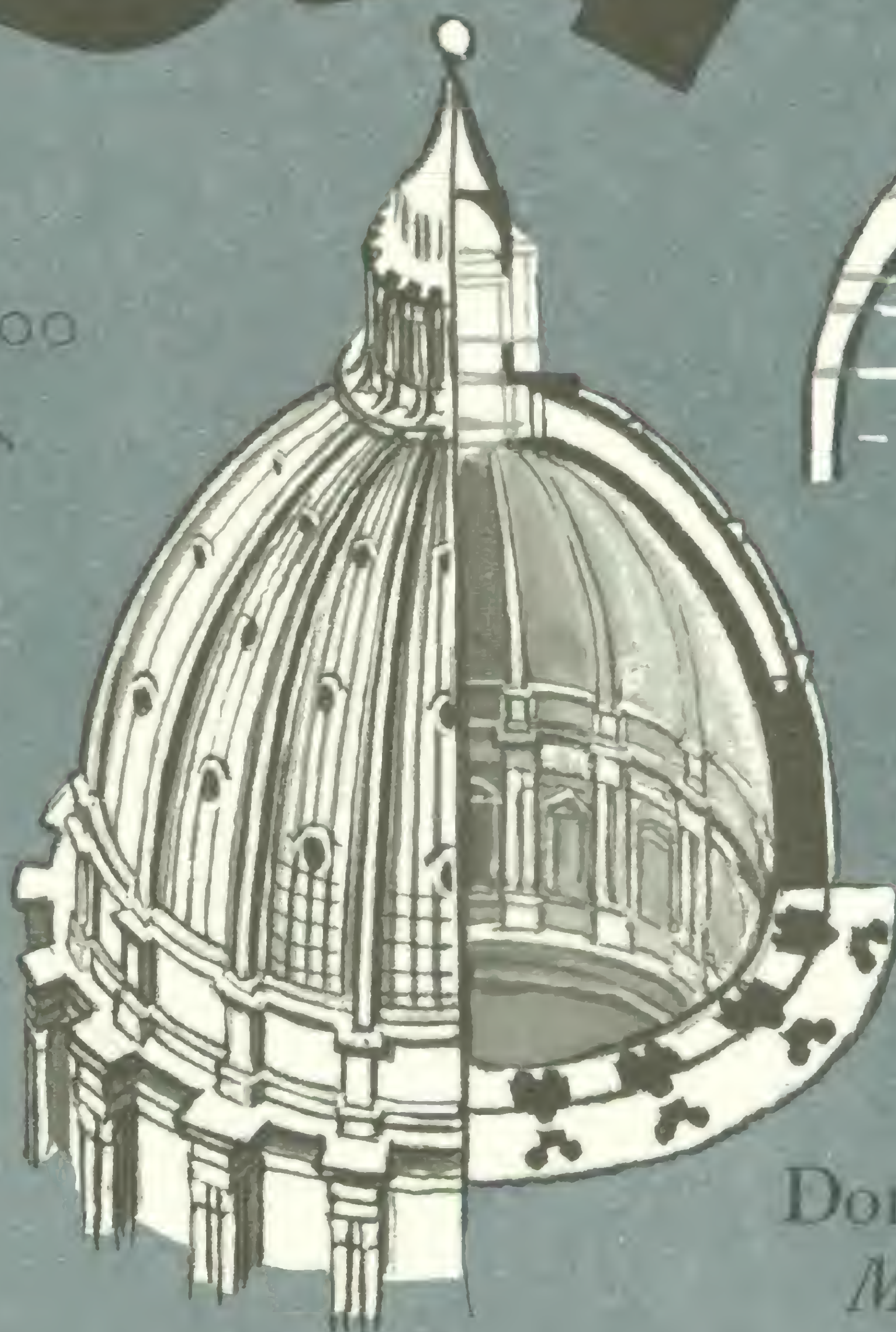
Florence  
Cathedral:  
Rome, 1420-34  
*Brunelleschi*  
(1377-1446)  
(pp. 91, 109, 116)



Tempietto, S. Pietro in  
Montorio, Rome, 1502-10  
*Bramante* (1444-1514)



St Peter's, Rome,  
1506-1625  
(pp. 91, 116)



Dome 1564-90  
*Michelangelo*  
(1475-1564)

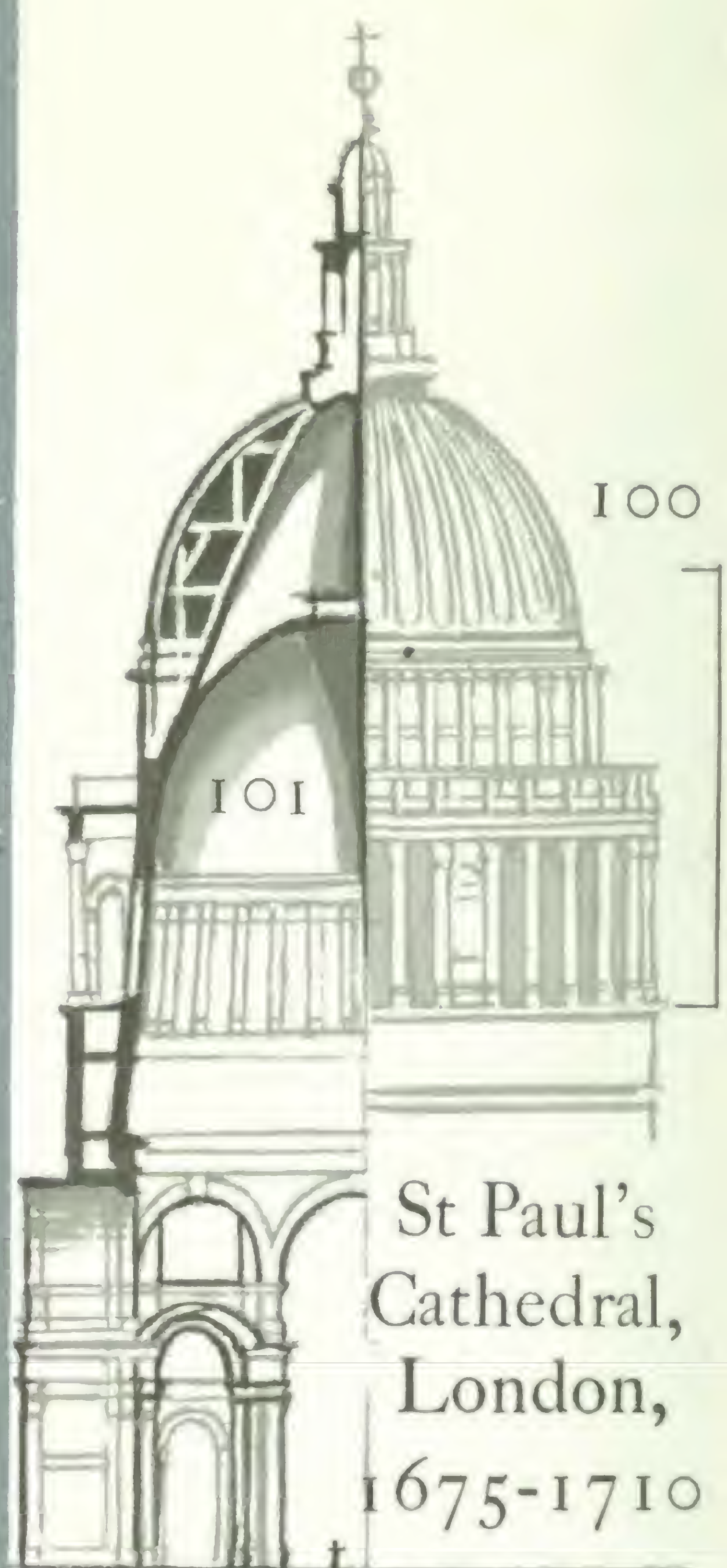
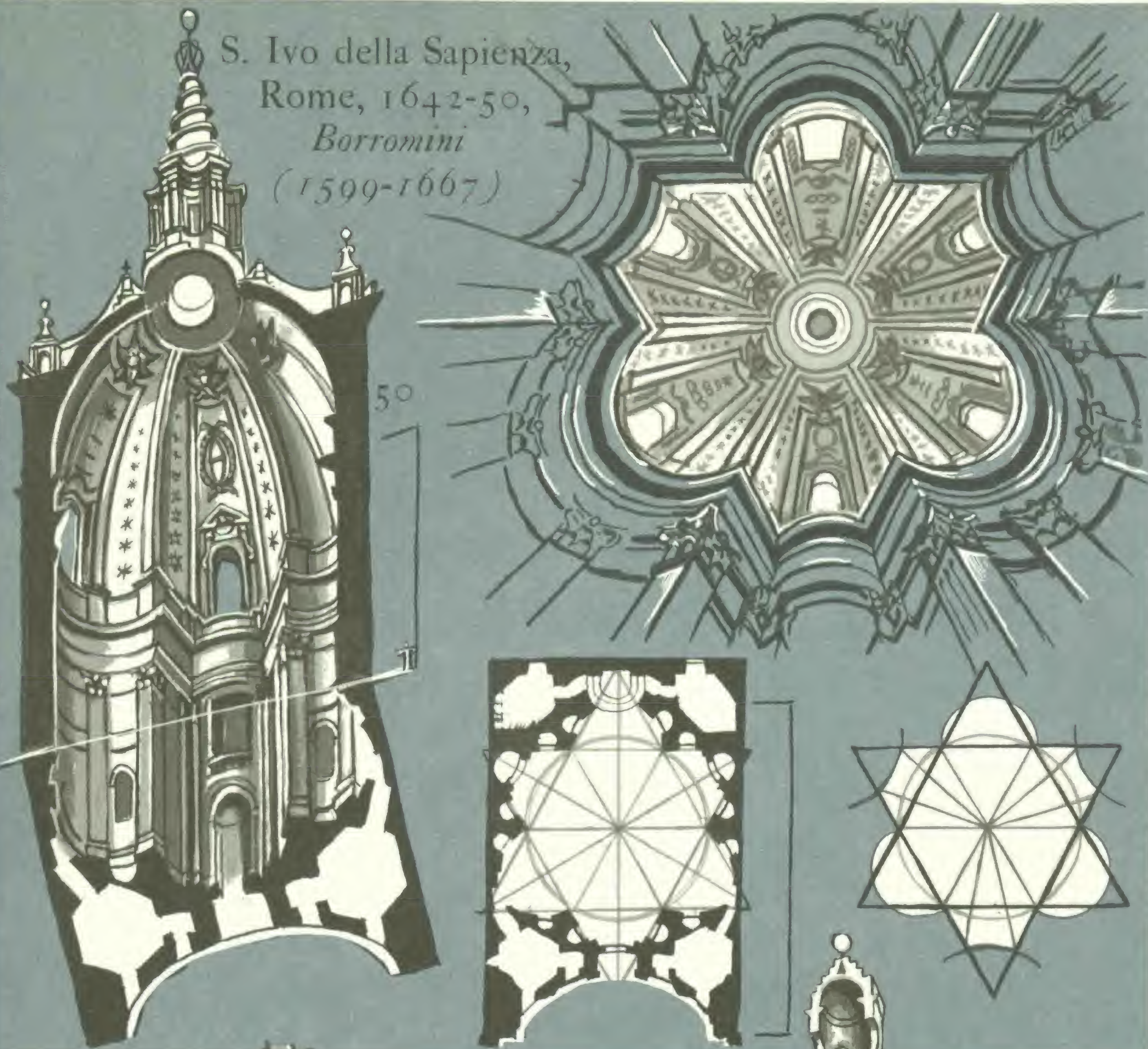


c, chains



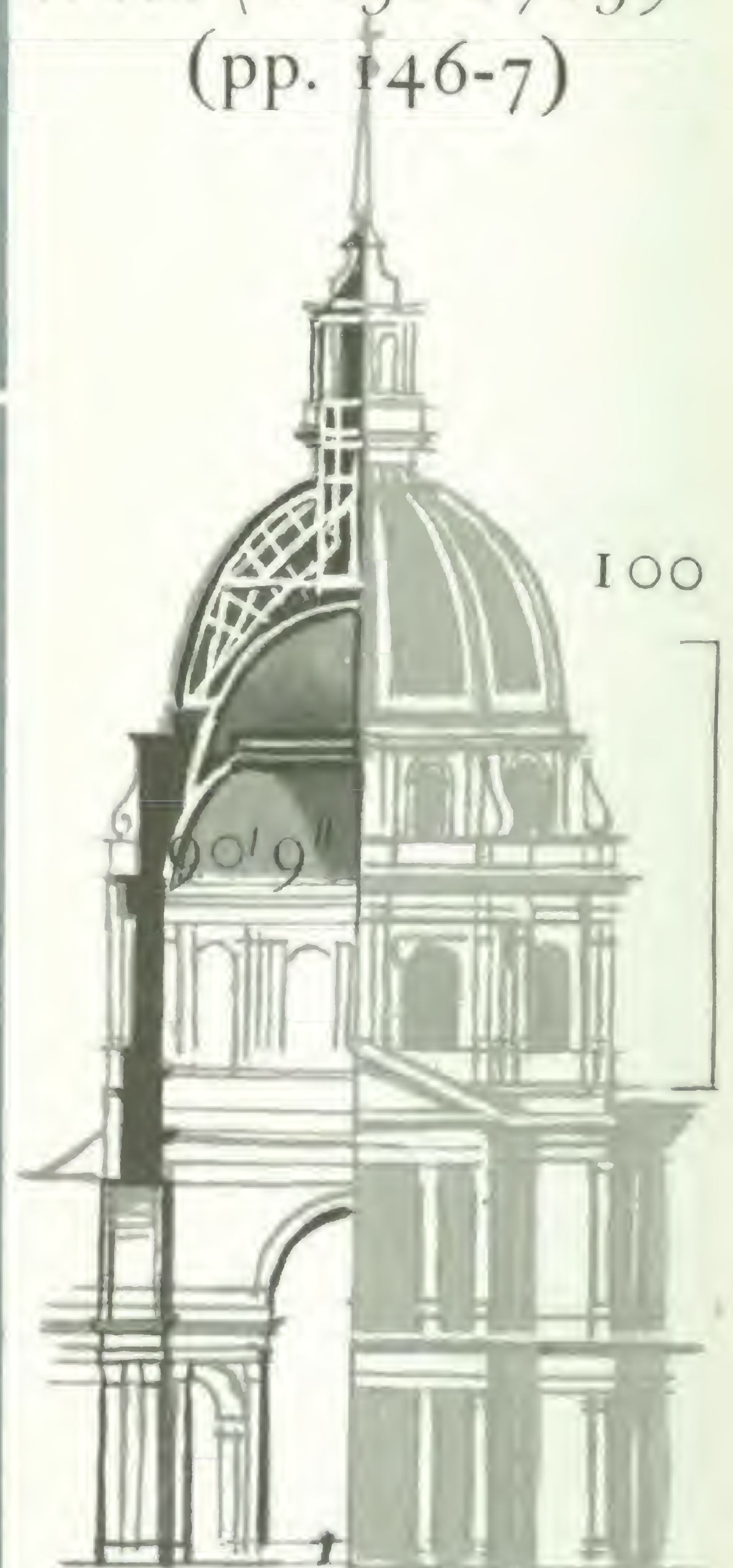
# ITALY, DOMES

S. Ivo della Sapienza,  
Rome, 1642-50,  
*Borromini*  
(1599-1667)



St Paul's  
Cathedral,  
London,  
1675-1710

*Wren* (1631-1723)  
(pp. 146-7)



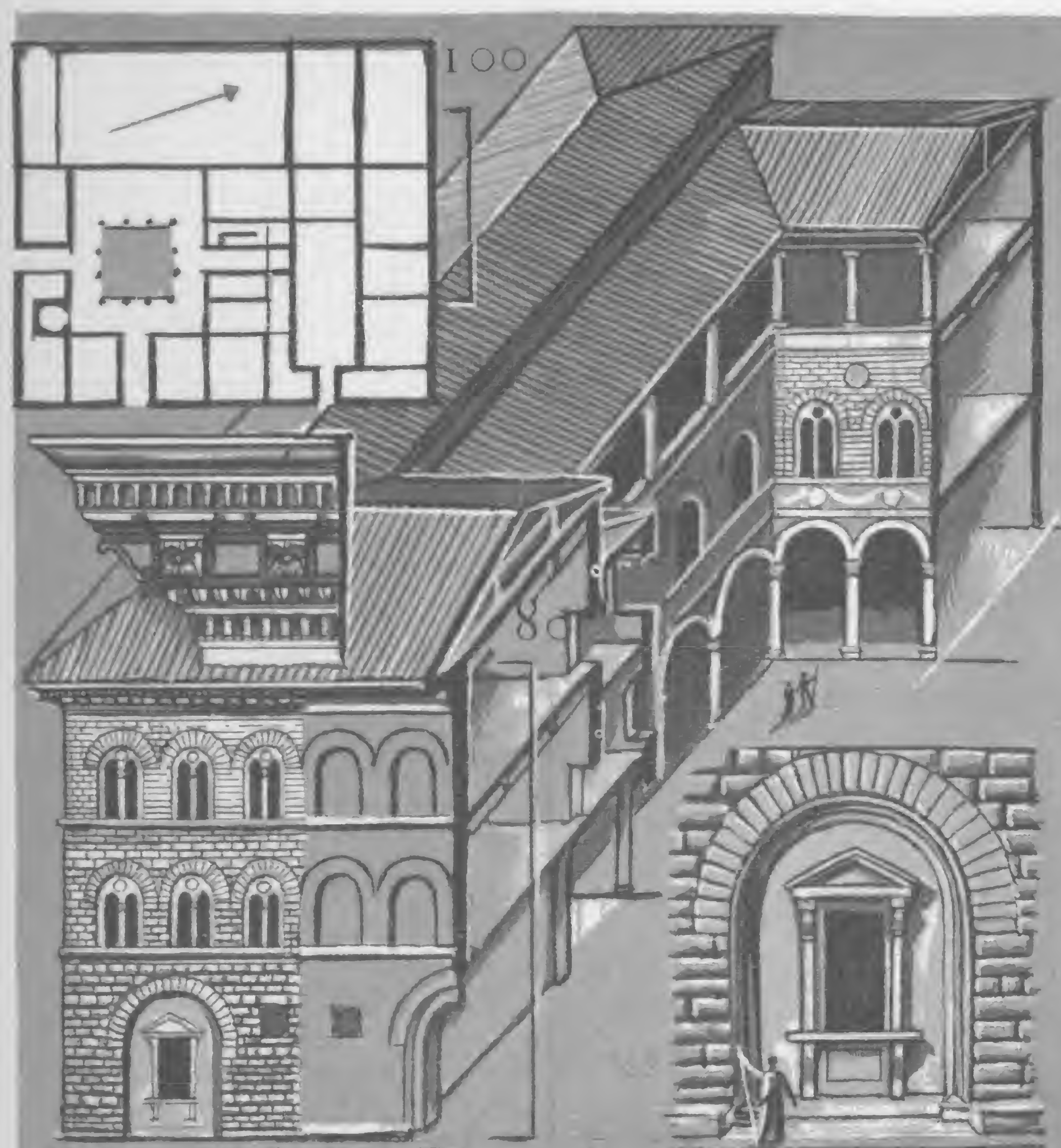
The Dome of the  
Invalides, Paris,  
1693-1706 *Jules  
Hardouin-Mansart*  
(1646-1708)  
(p. 131)



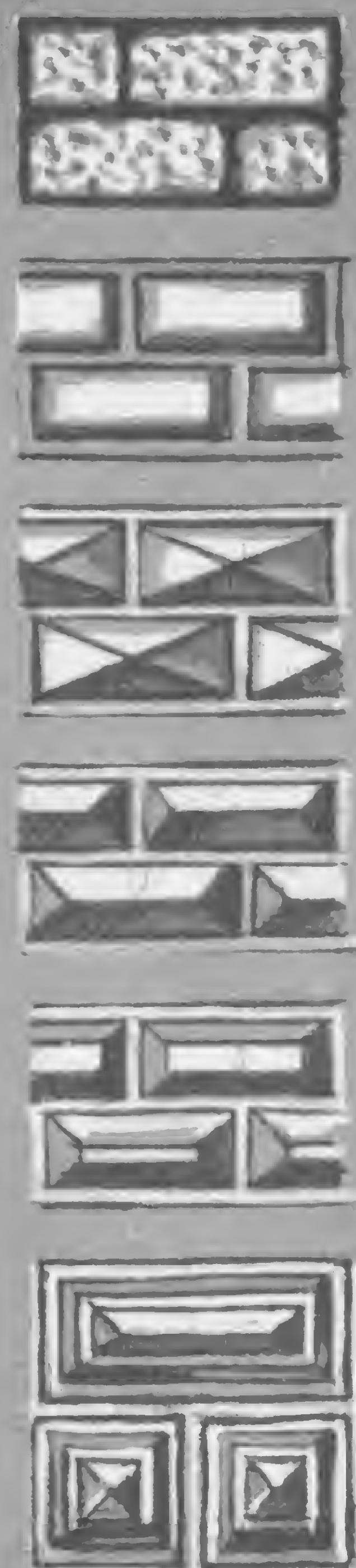
Sanctuary, Vallinotto, near Turin, 1738-9  
*Bernard Vittone* (1704/5-70)



# RENAISSANCE - BAROQUE



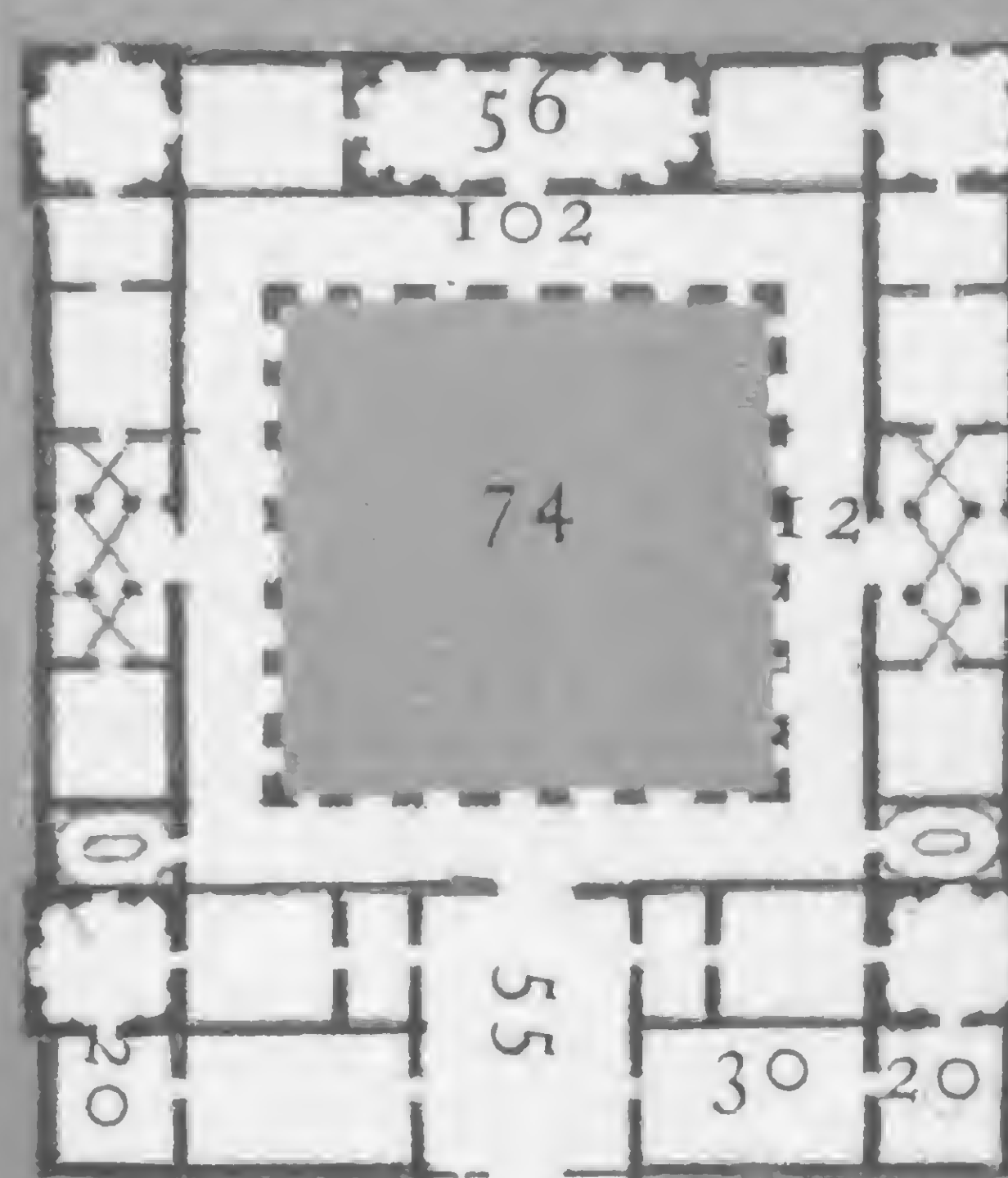
Palazzo Medici-Riccardi, Florence, 1430  
*Michelozzo (1397-1473)*



rusticated  
masonry  
after  
*Serlio*



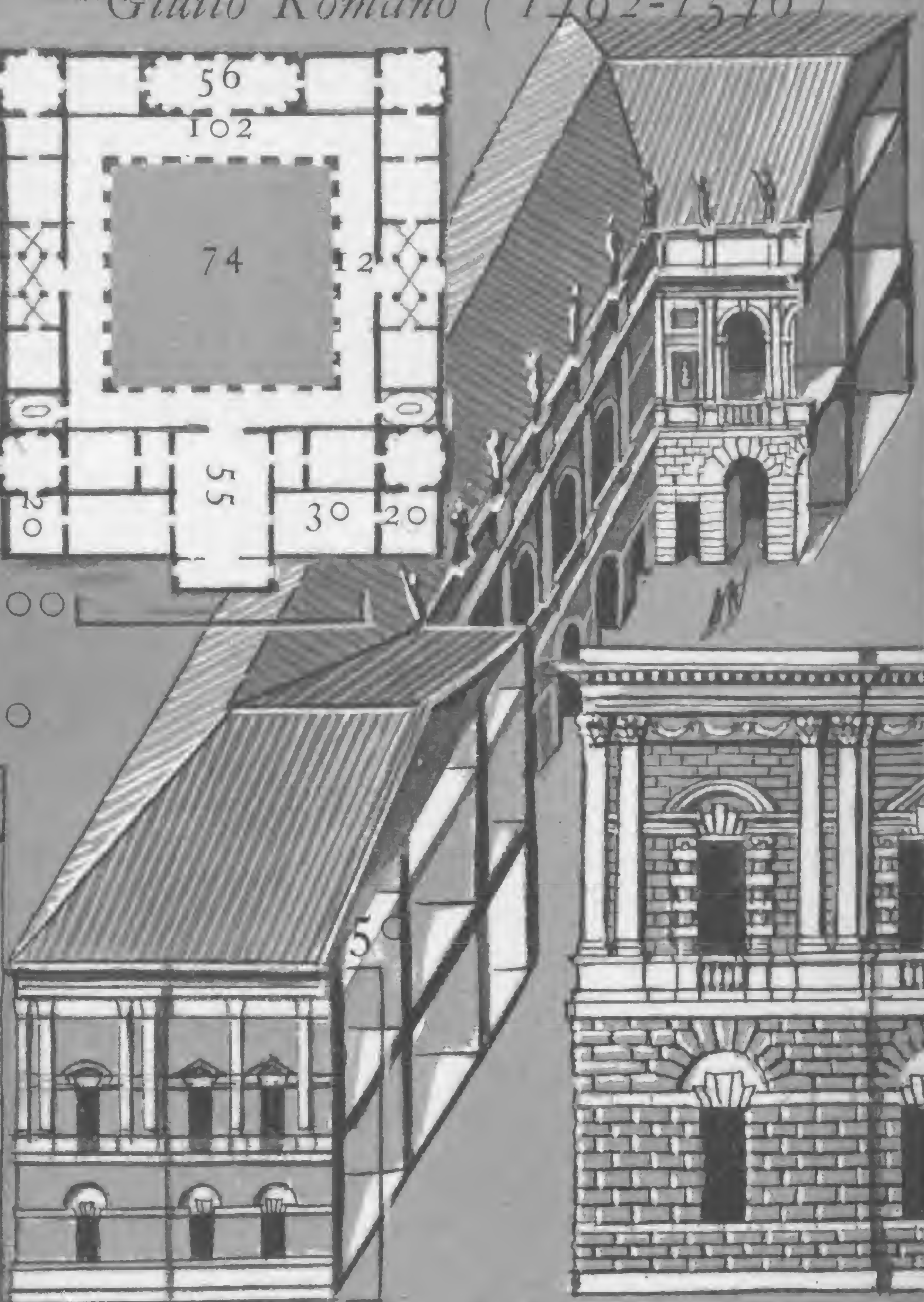
Palazzo del Tè, Mantua, 1526-35  
*Giulio Romano (1492-1546)*



Doric Ionic Corinthia



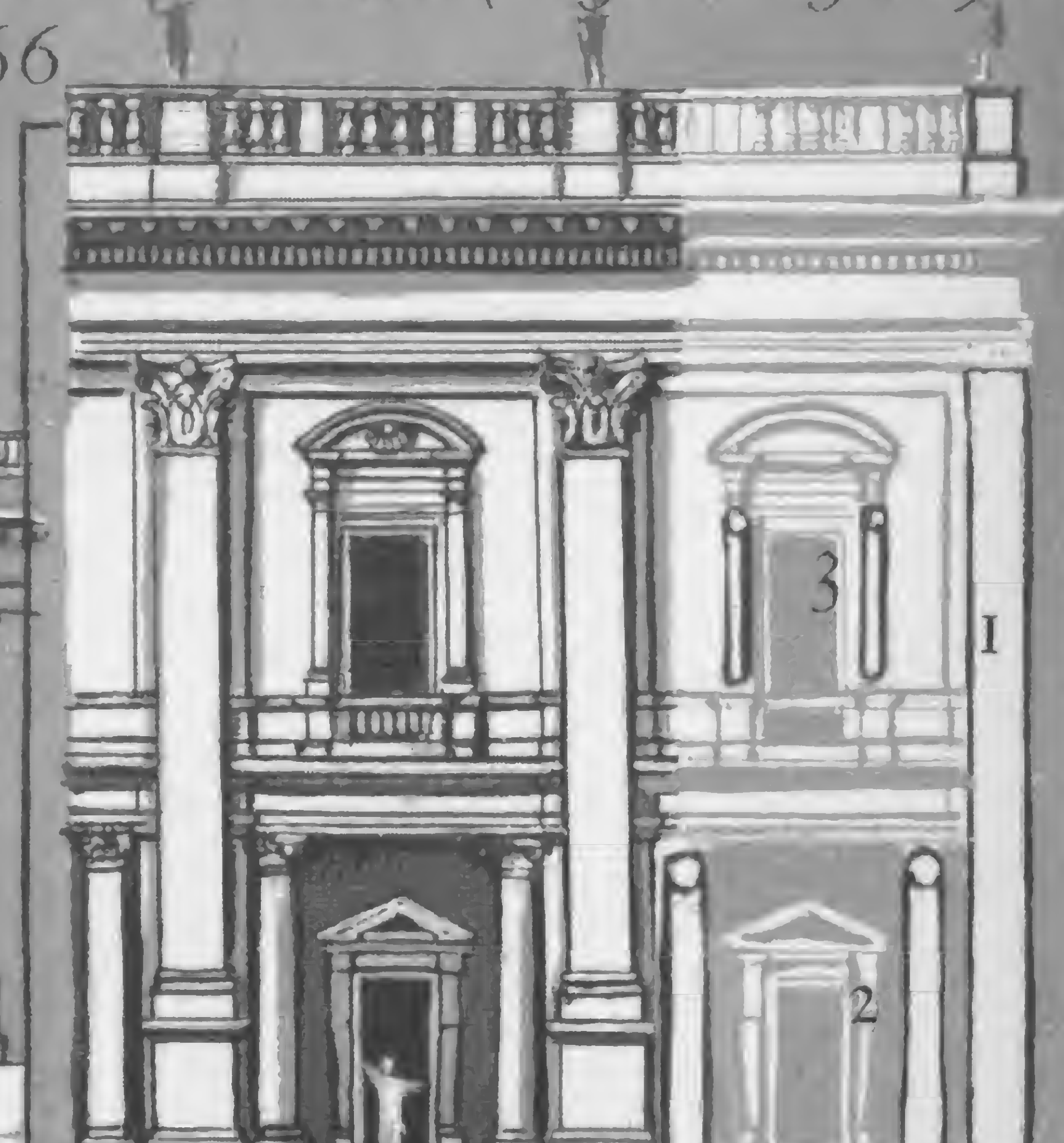
Palazzo Rucellai, Florence, 1451  
*Alberti (1404-72)*



Palazzo Thiene, Vicenza, 1556-58  
*Andrea Palladio (1508-1580)*



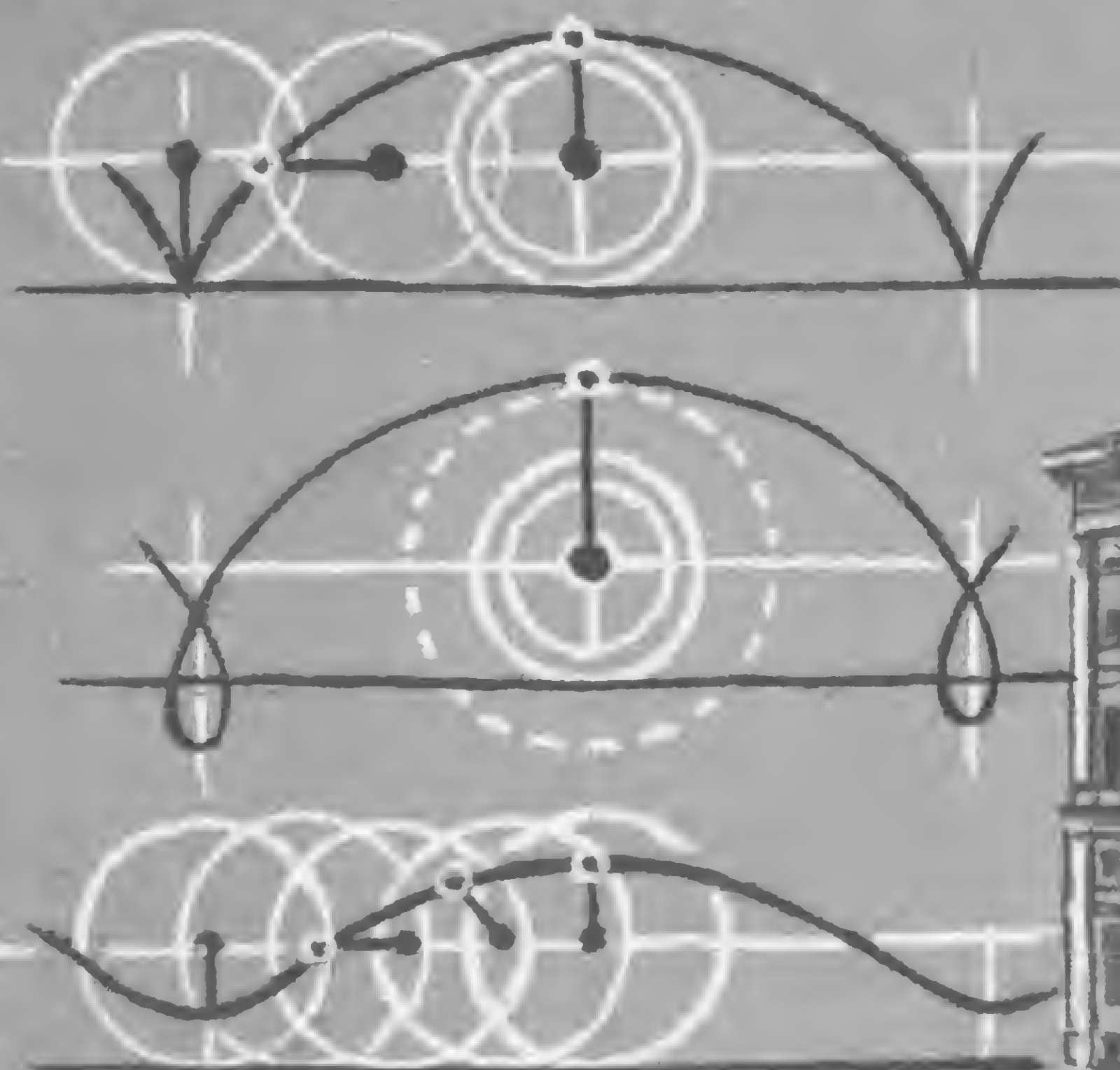
The Capitol, Rome, 1540-1644, *Michelangelo (1475-1564)*



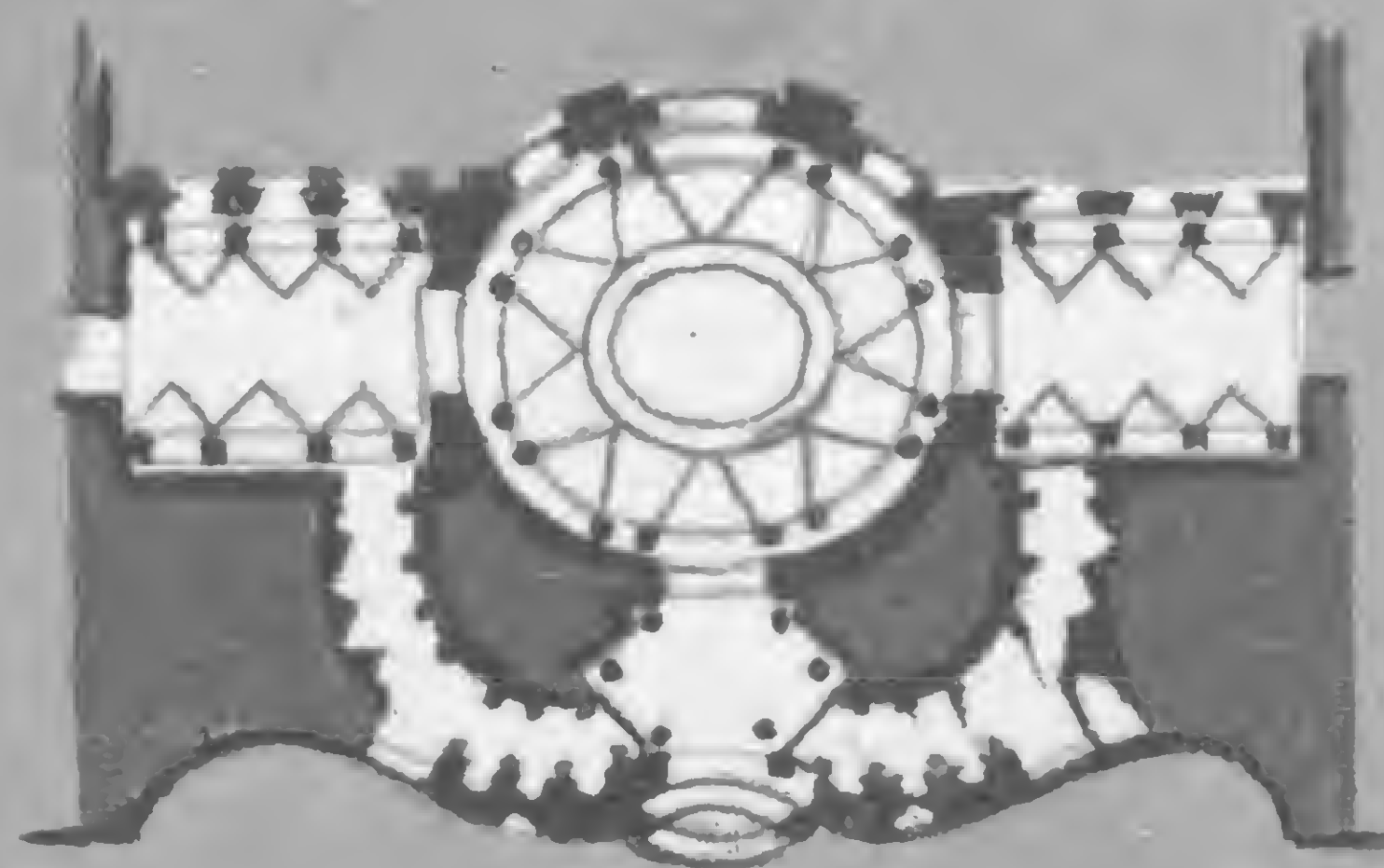
The 'Colossal' Order



# ITALY, PALACES

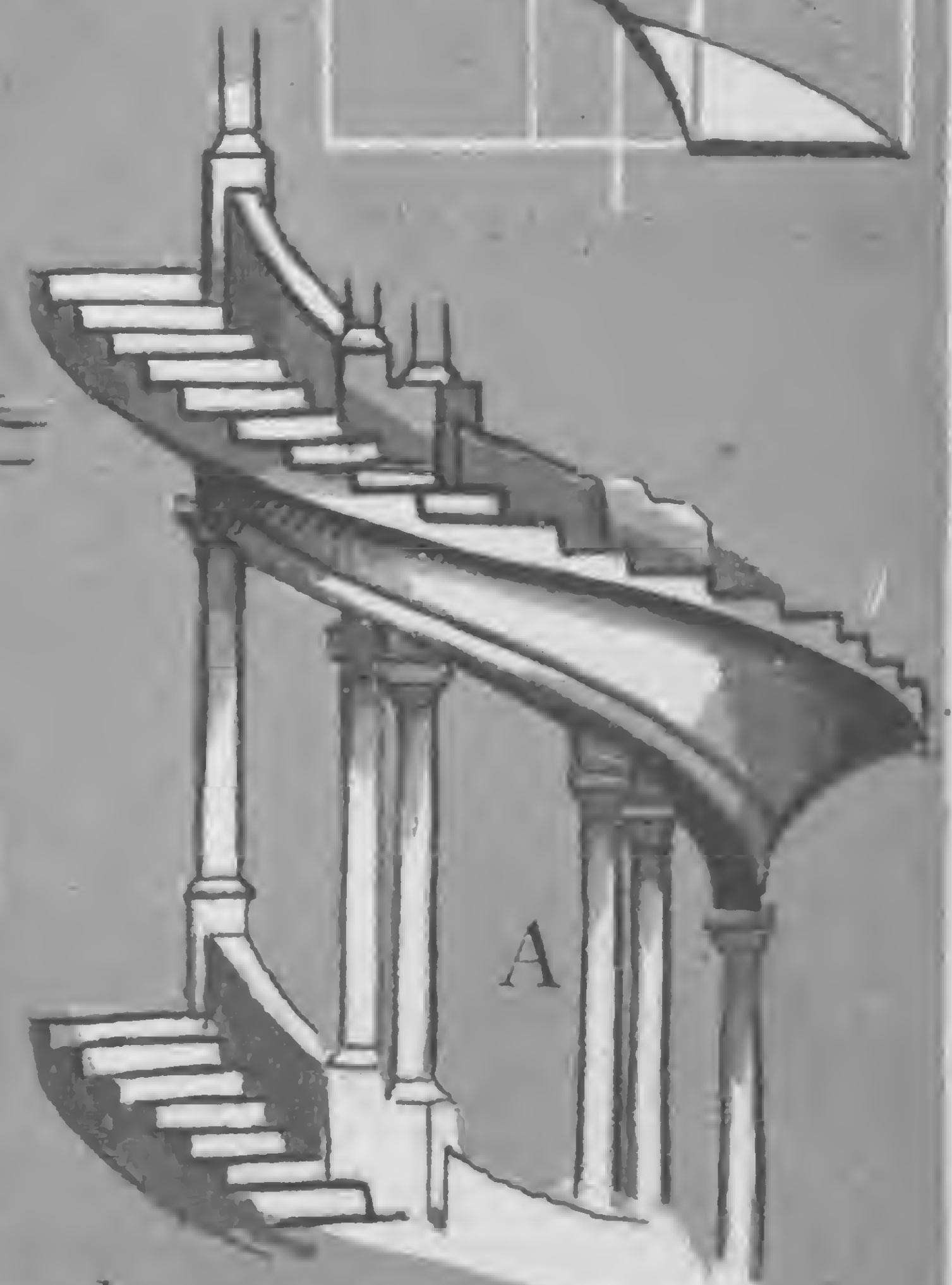
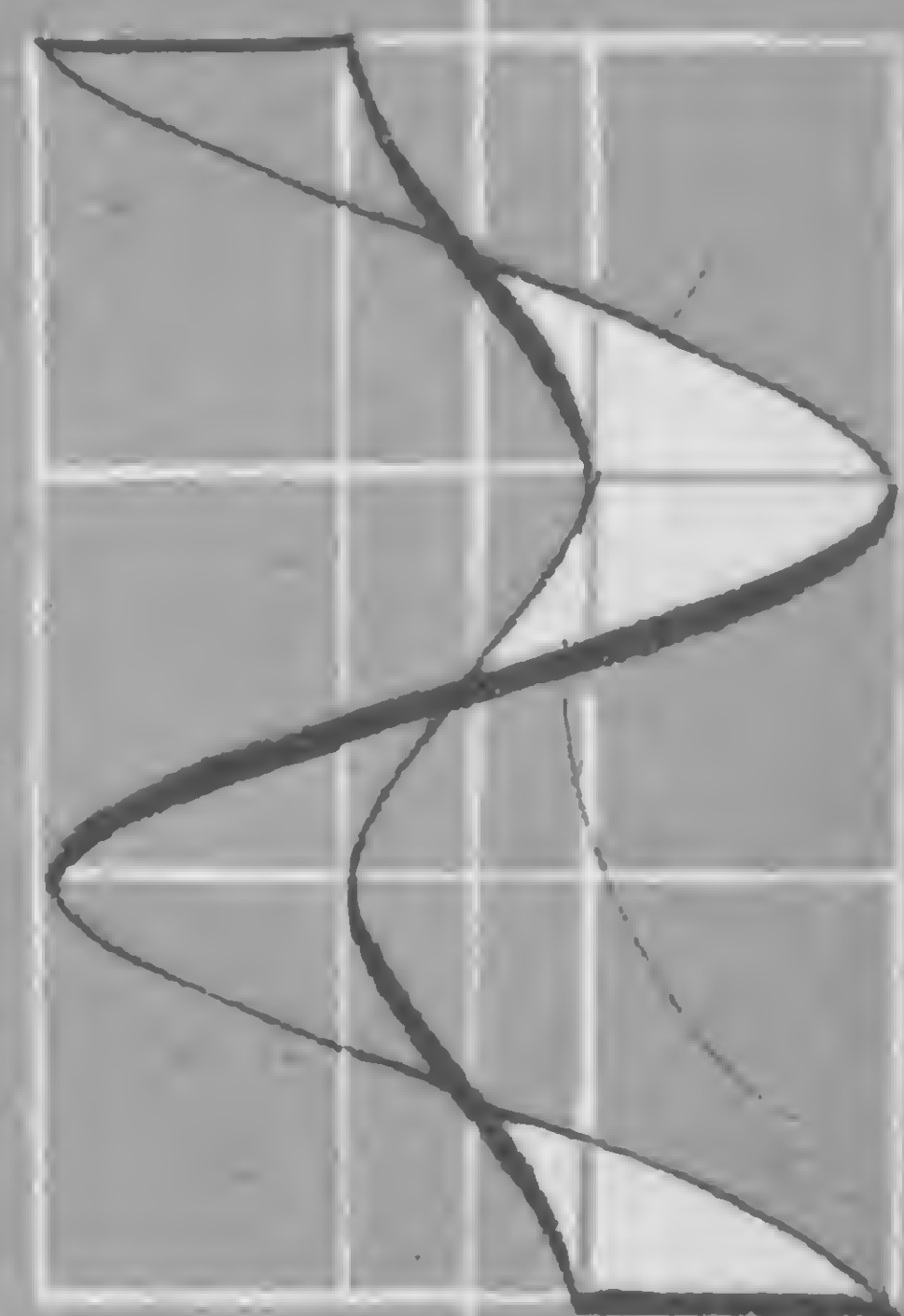
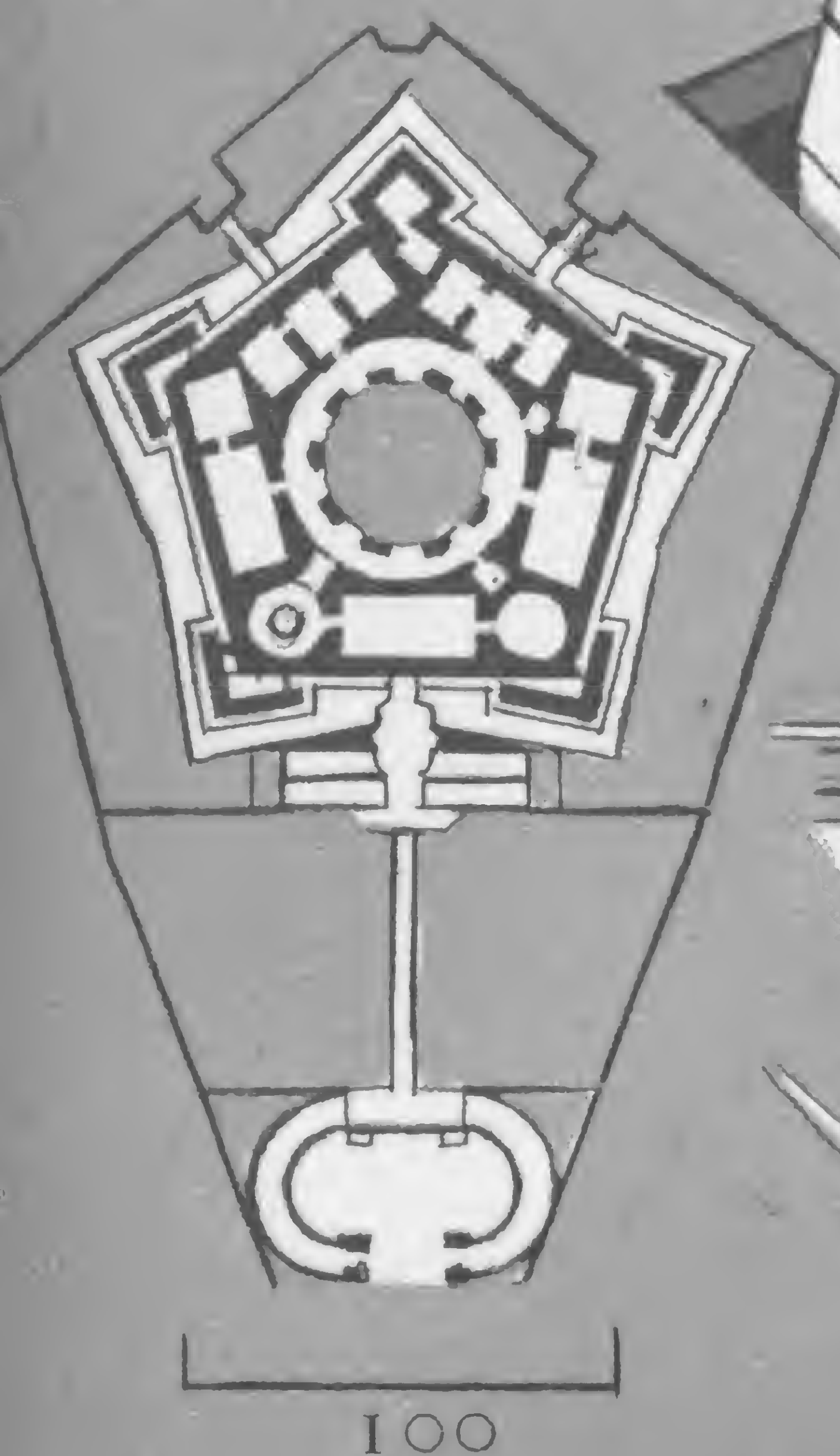
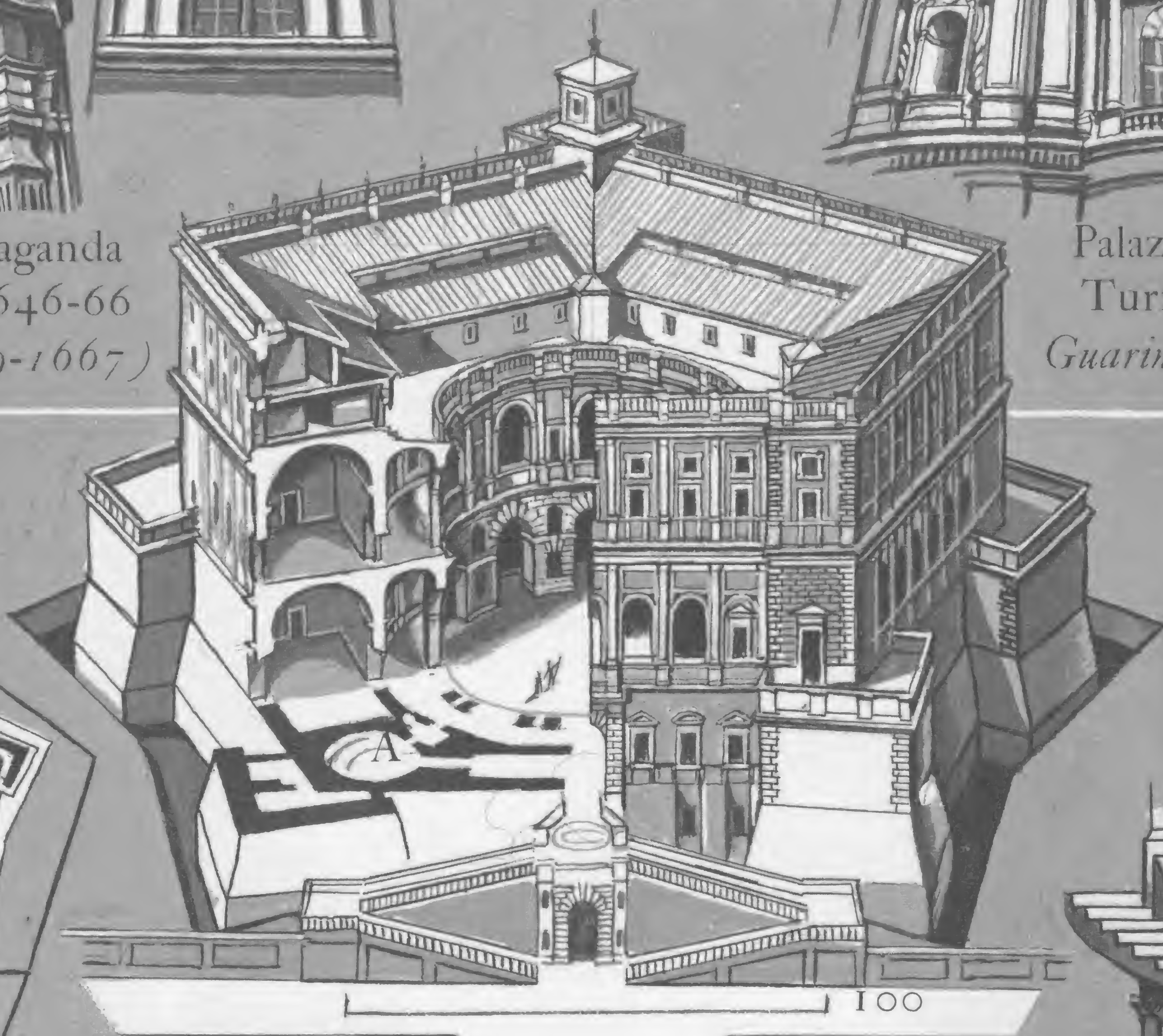


cycloidal curves  
*Pascal (1623-1662)*



Collegio Propaganda  
Fide, Rome 1646-66  
*Borromini (1599-1667)*

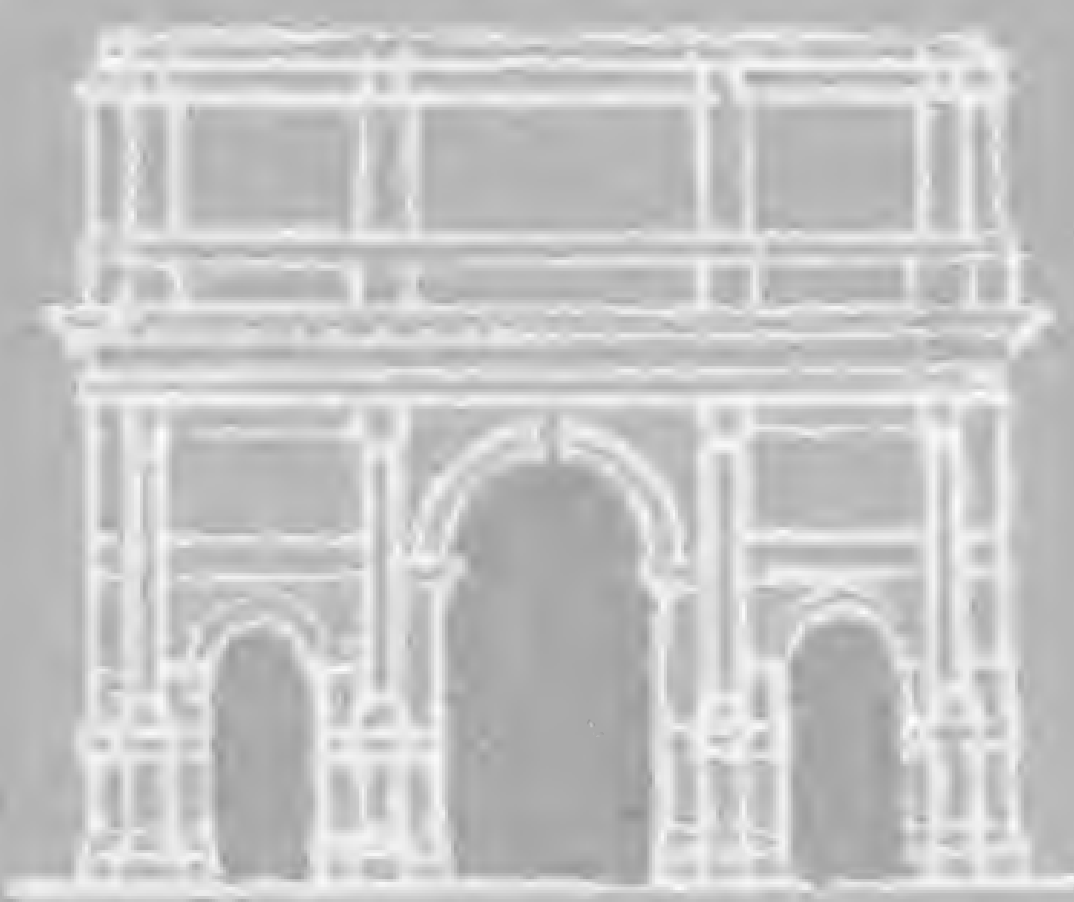
Palazzo Carignano,  
Turin, c.1678-80  
*Guarini (1624-1683)*



Palazzo Farnese, Caprarola, 1559-1564 *Giacomo Barozzi da Vignola (1507-1573)*



# RENAISSANCE-BAROQUE



(p. 117)



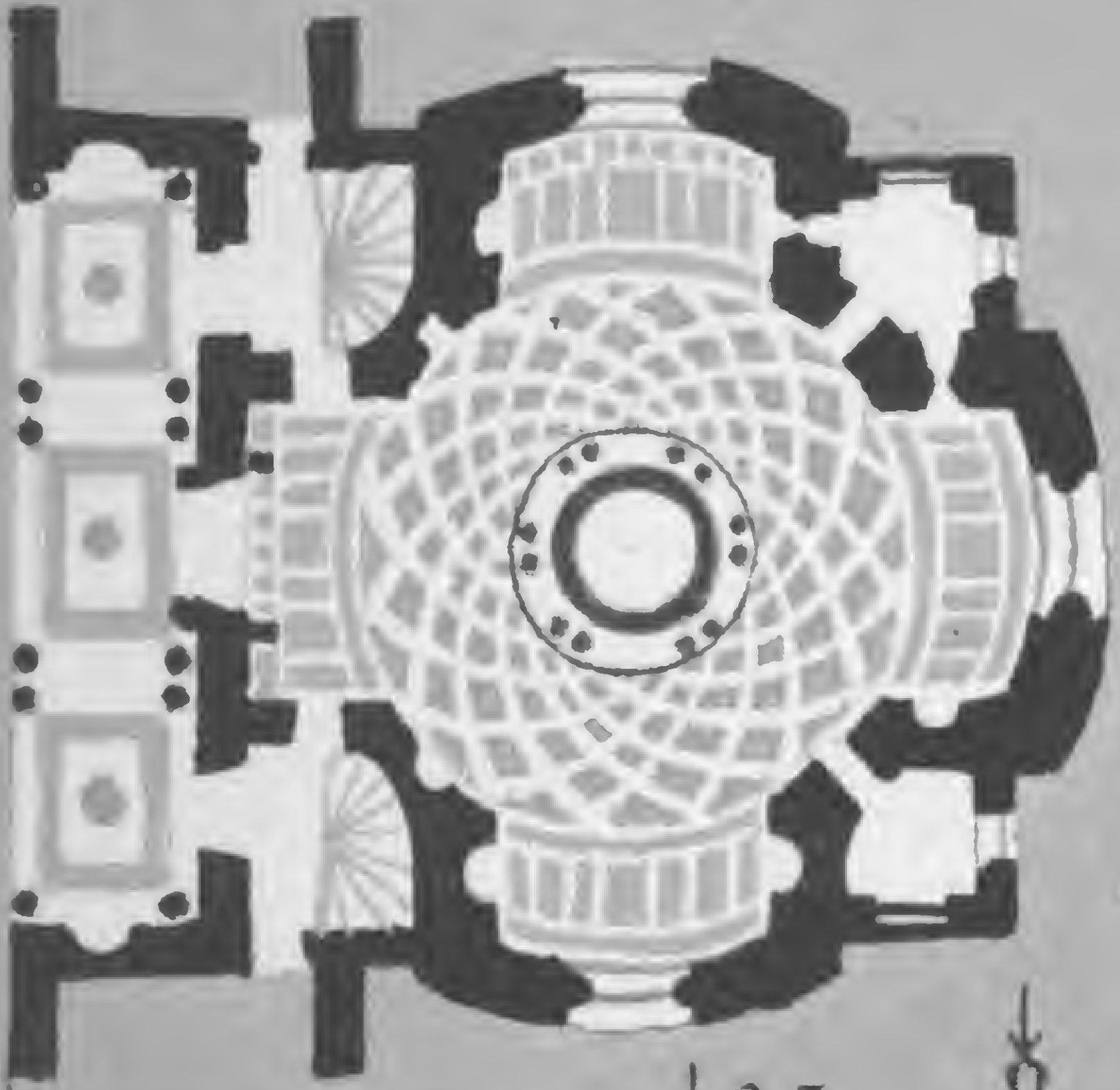
after Serlio  
1537



150

50

St Gervais, Paris:  
façade, 1616  
*Salomon de Brosse*  
(c.1562-1626)



25



Château d'Anet: chapel, 1549-53  
*Philibert de l'Orme* (c.1510-1570)



Church of the Sorbonne, Paris, c.1635  
*Jacques Lemercier* (c.1580/5-1654)

The Italian campaigns of the French Kings, Charles VIII (1483-98), Louis XII (1498-1515) and Francis I (1515-47), failed in their aims; instead France was invaded by the ideas and the arts of the Italian Renaissance.



# FRANCE, CHURCHES



(pp. 56, 117)



(p. 124)

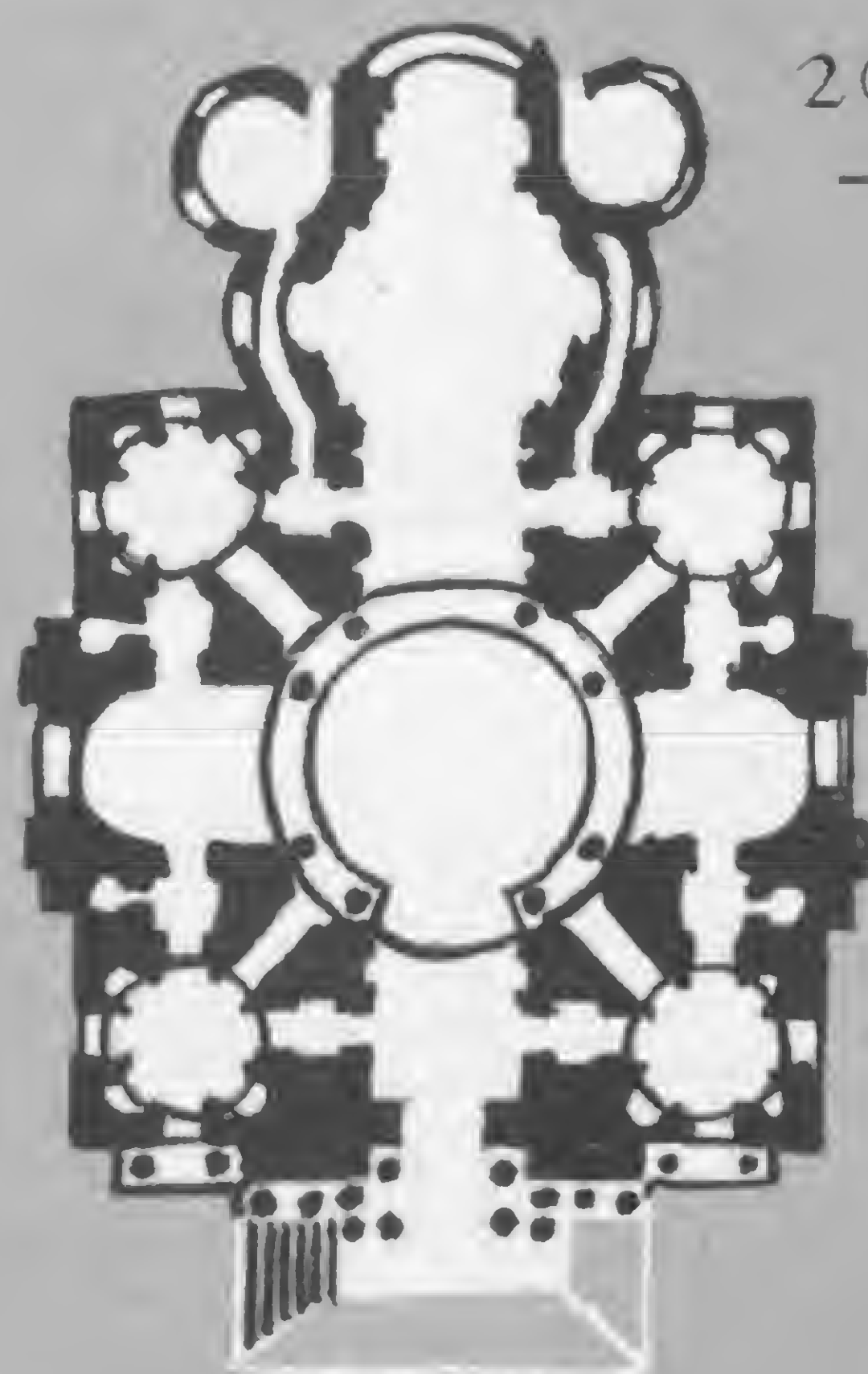


300

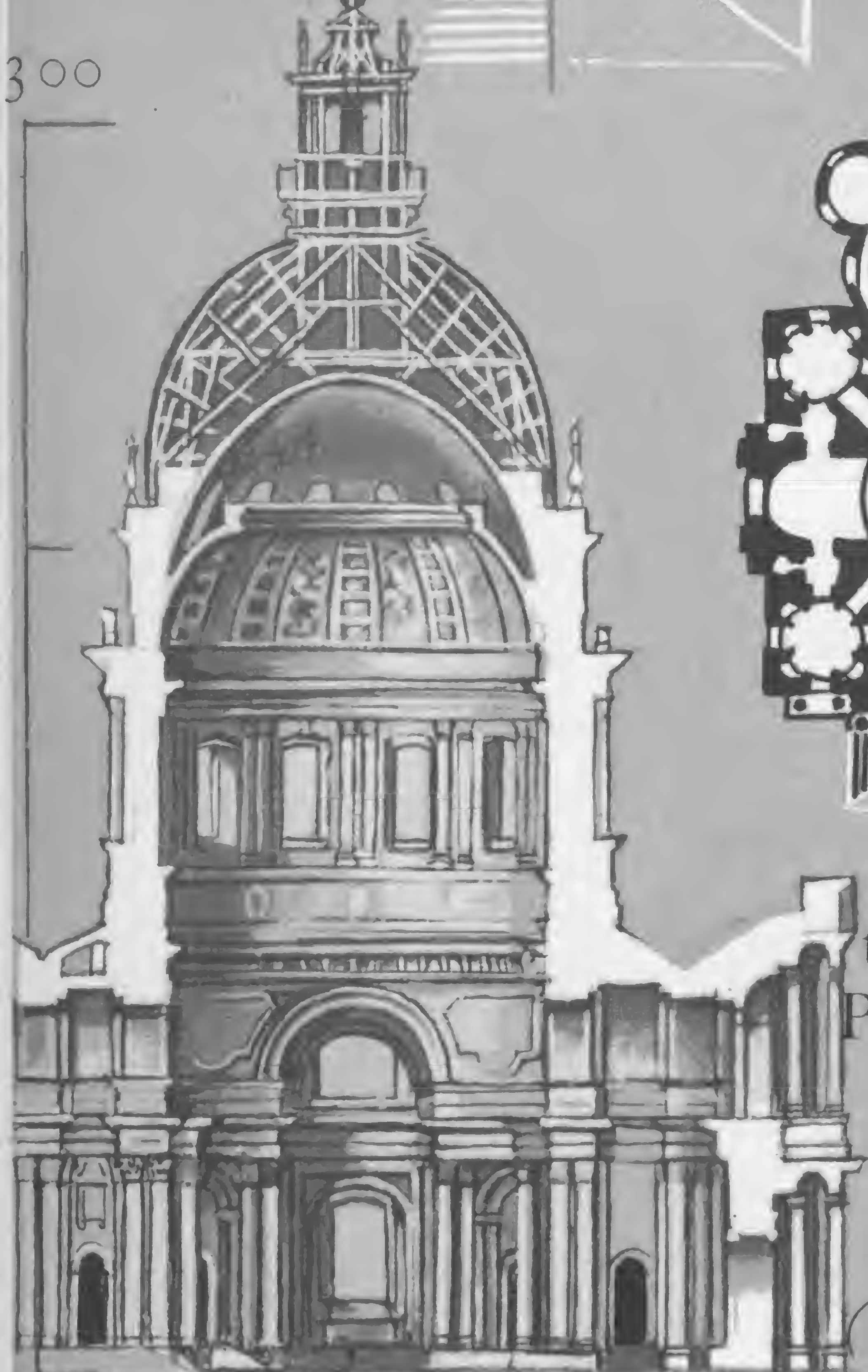
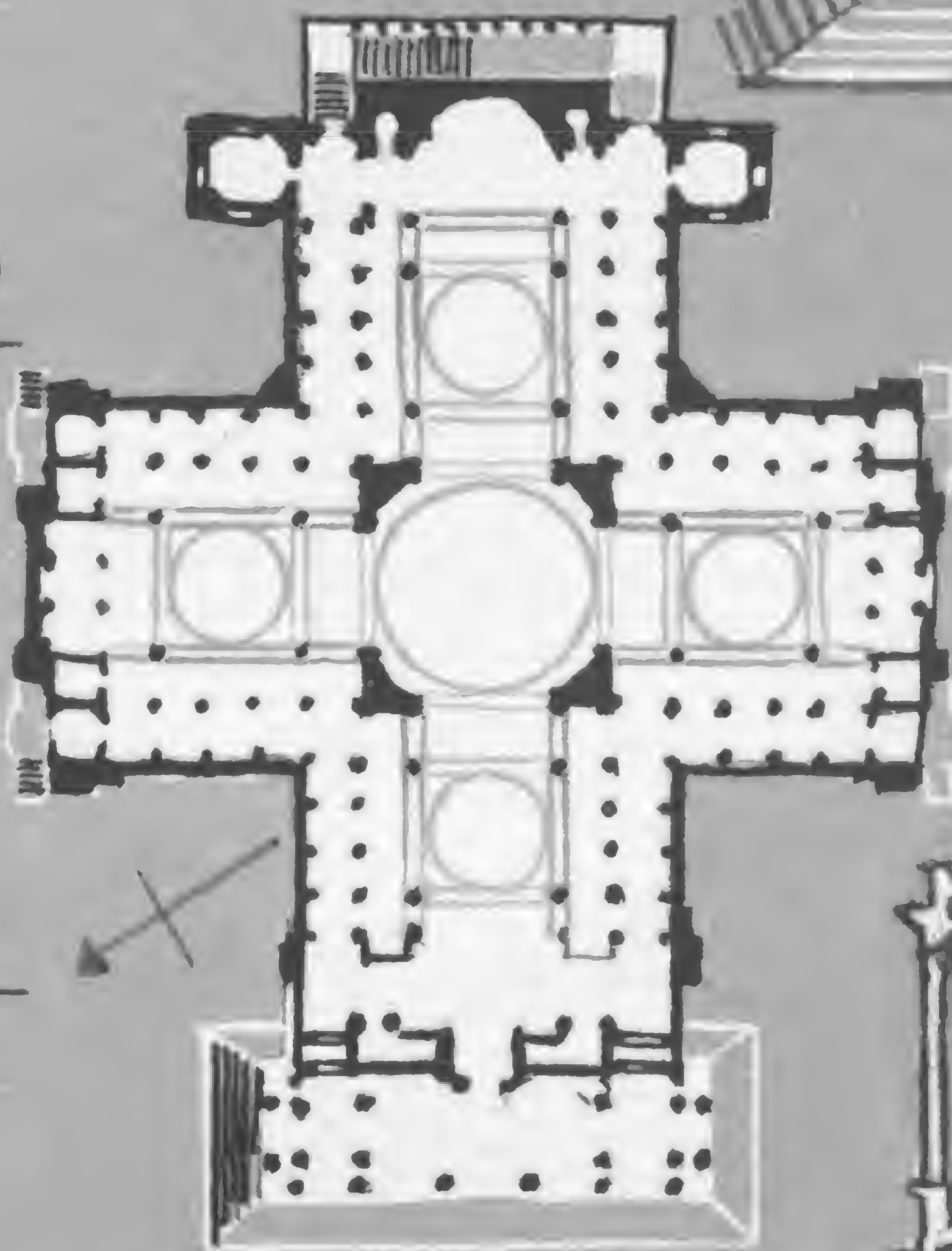
150

100

300

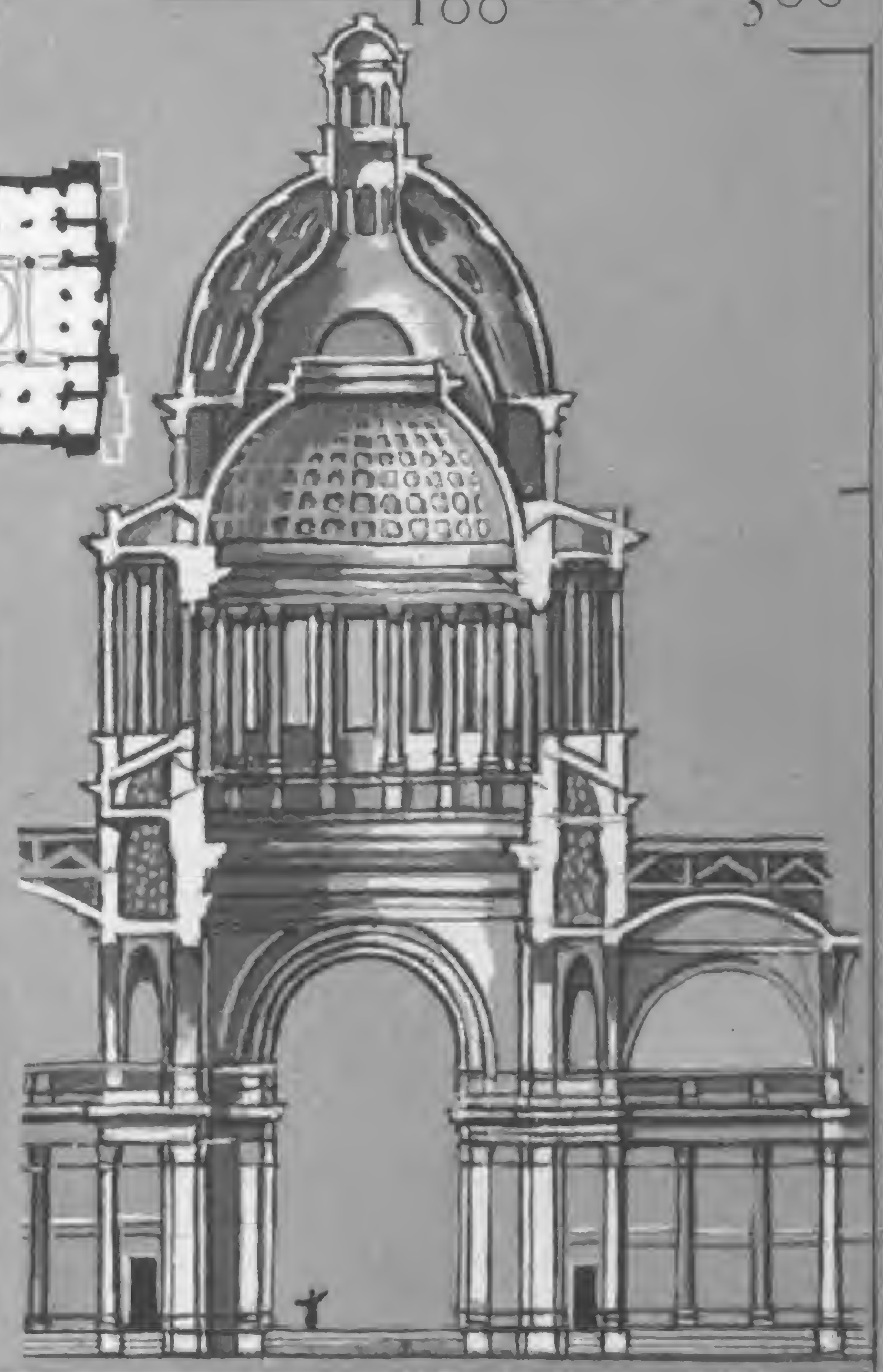


200



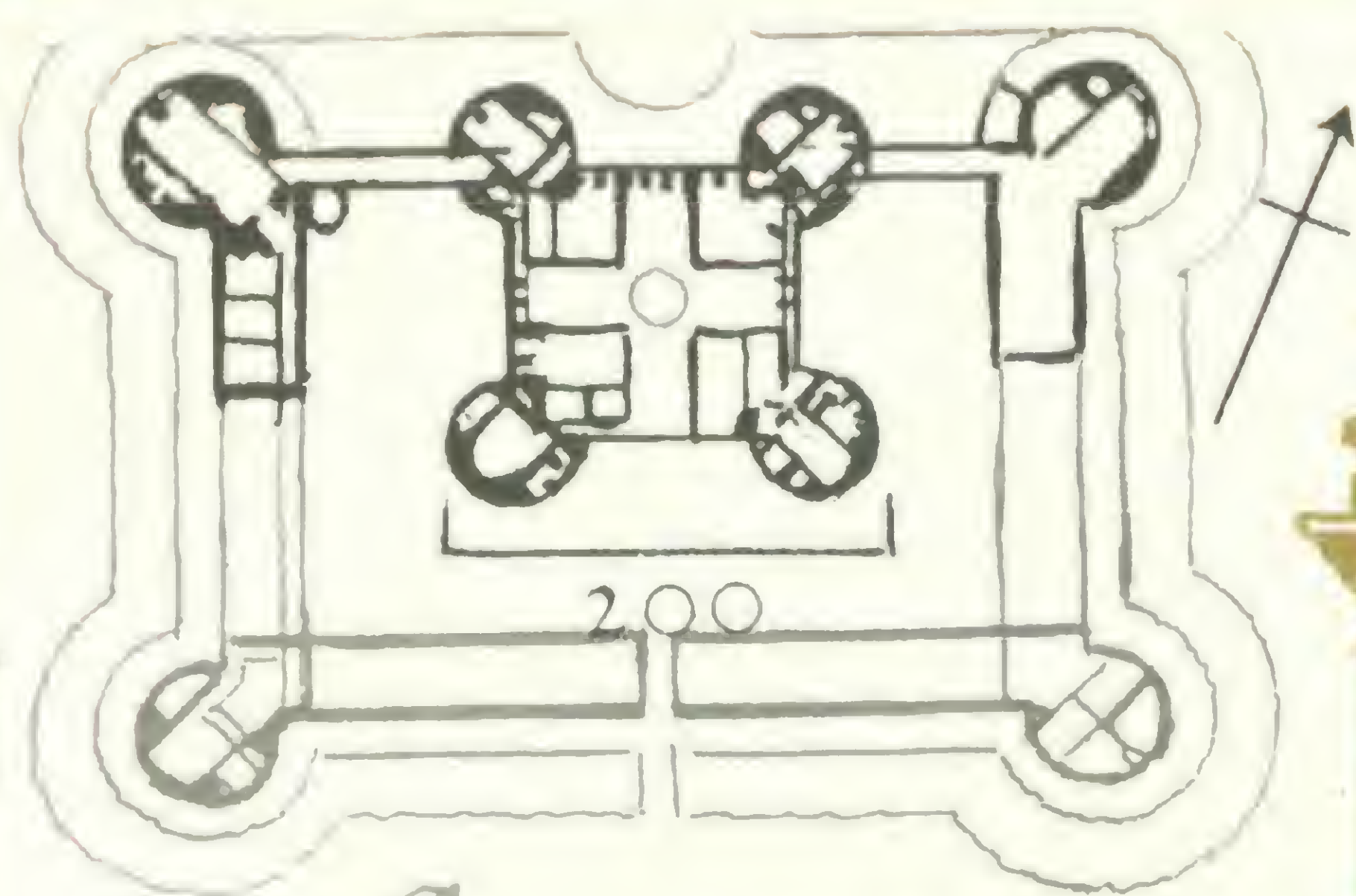
Church of  
the Invalides,  
Paris, 1680-91  
*Jules  
Hardouin  
Mansart*  
(1646-1708)

Panthéon  
(St G  n  vi  ve),  
Paris, 1764-90  
*Jacques-  
Germain  
Soufflot*  
(1713-80)

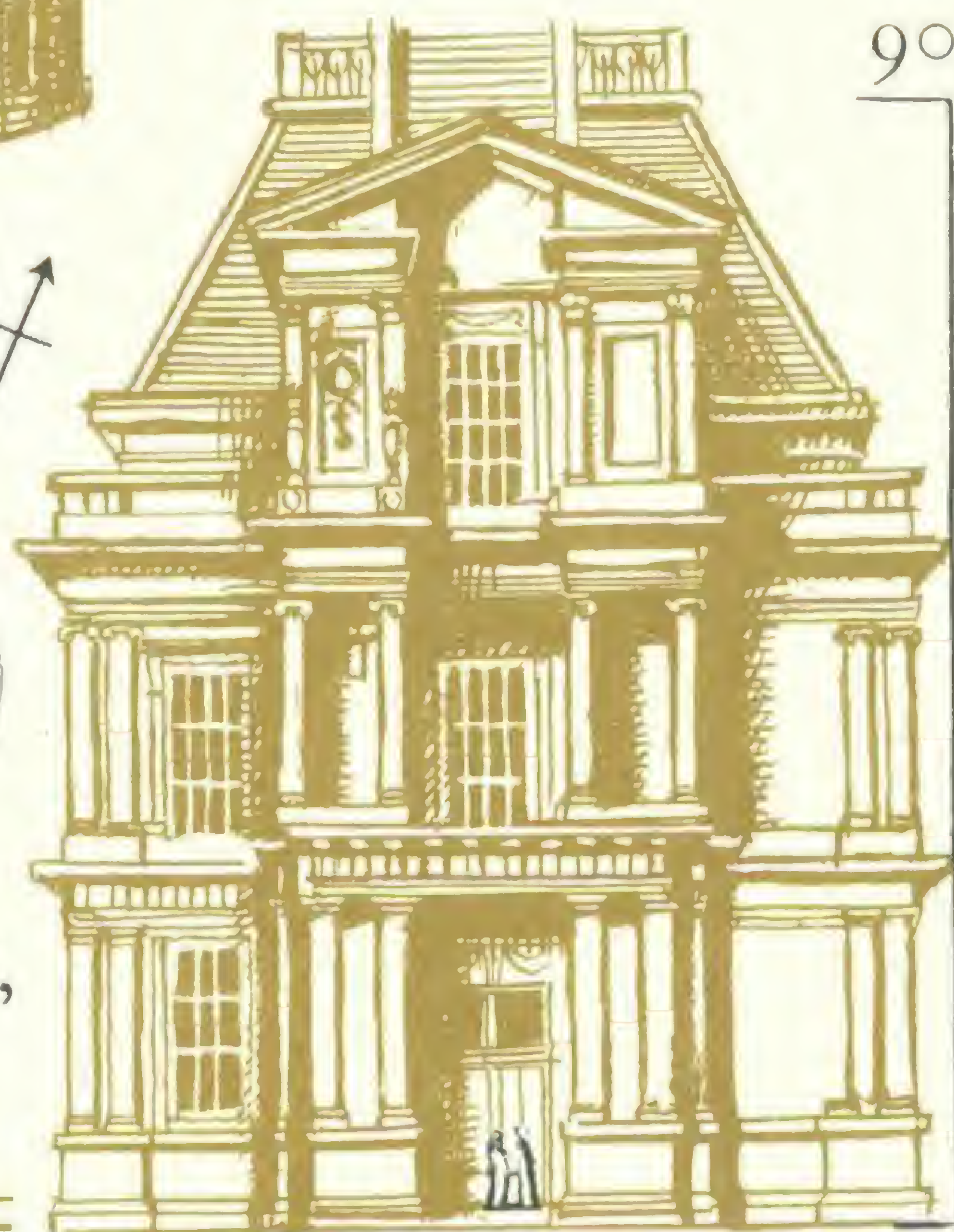




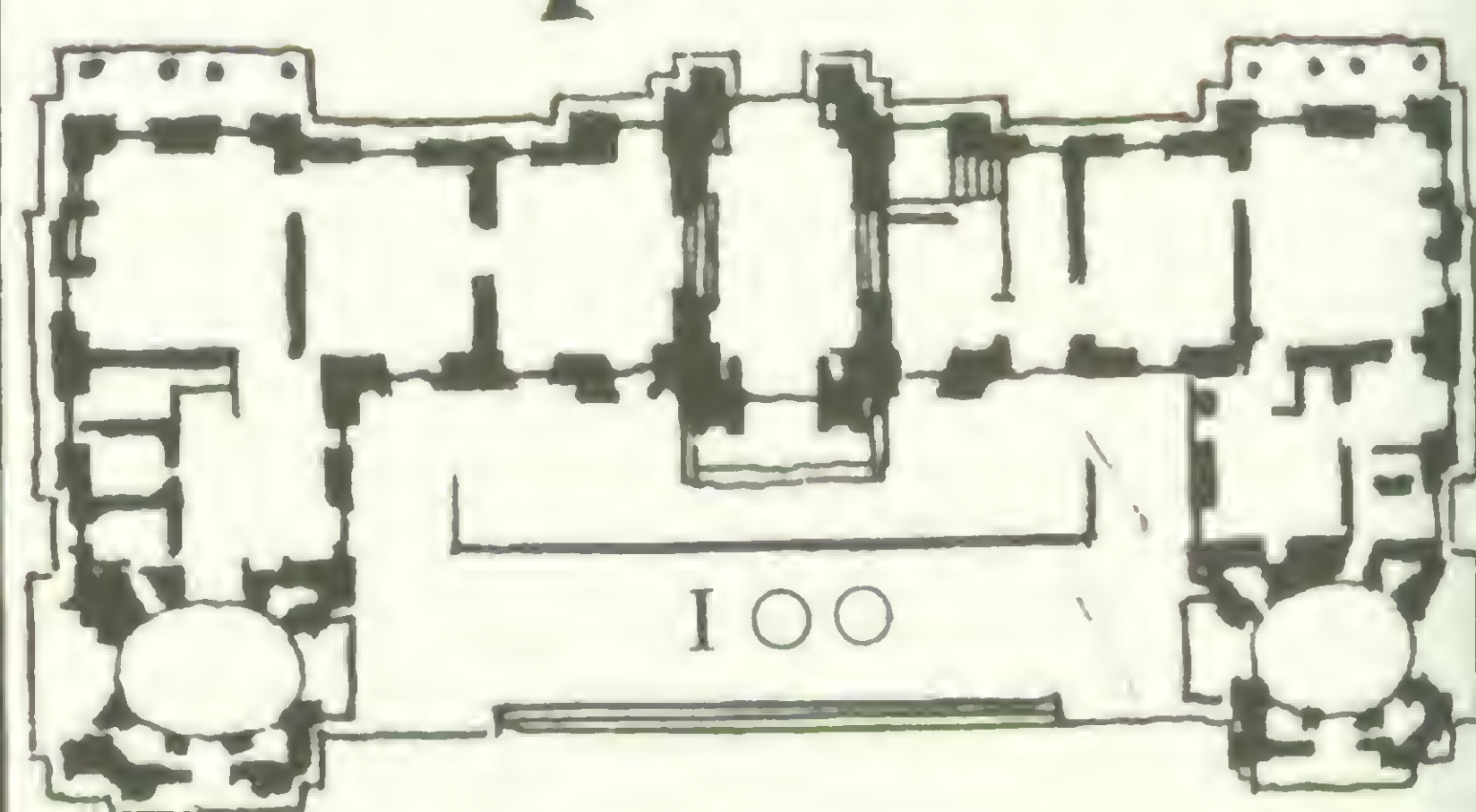
# RENAISSANCE-BAROQUE



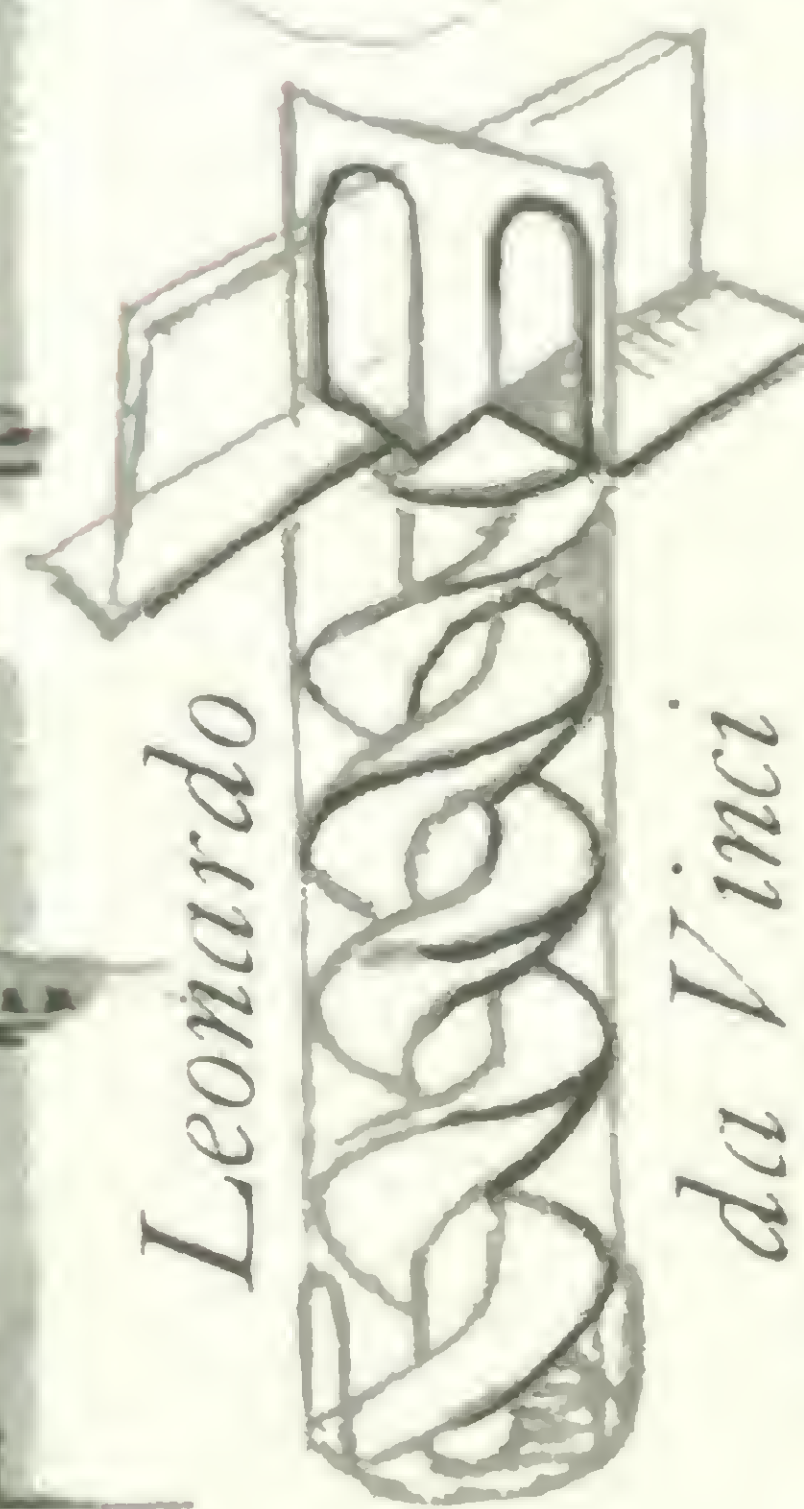
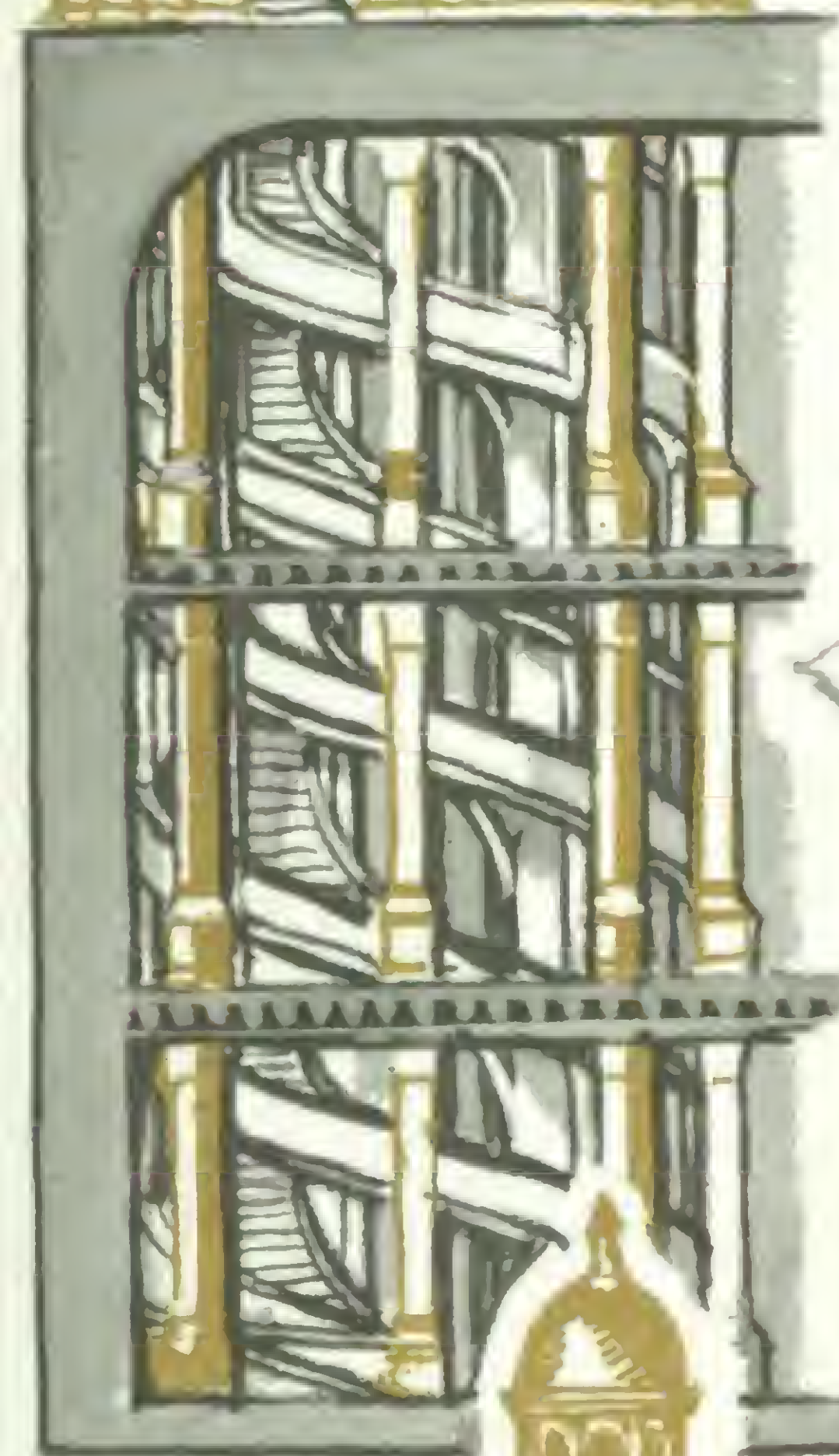
Château de Chambord,  
1519-1547



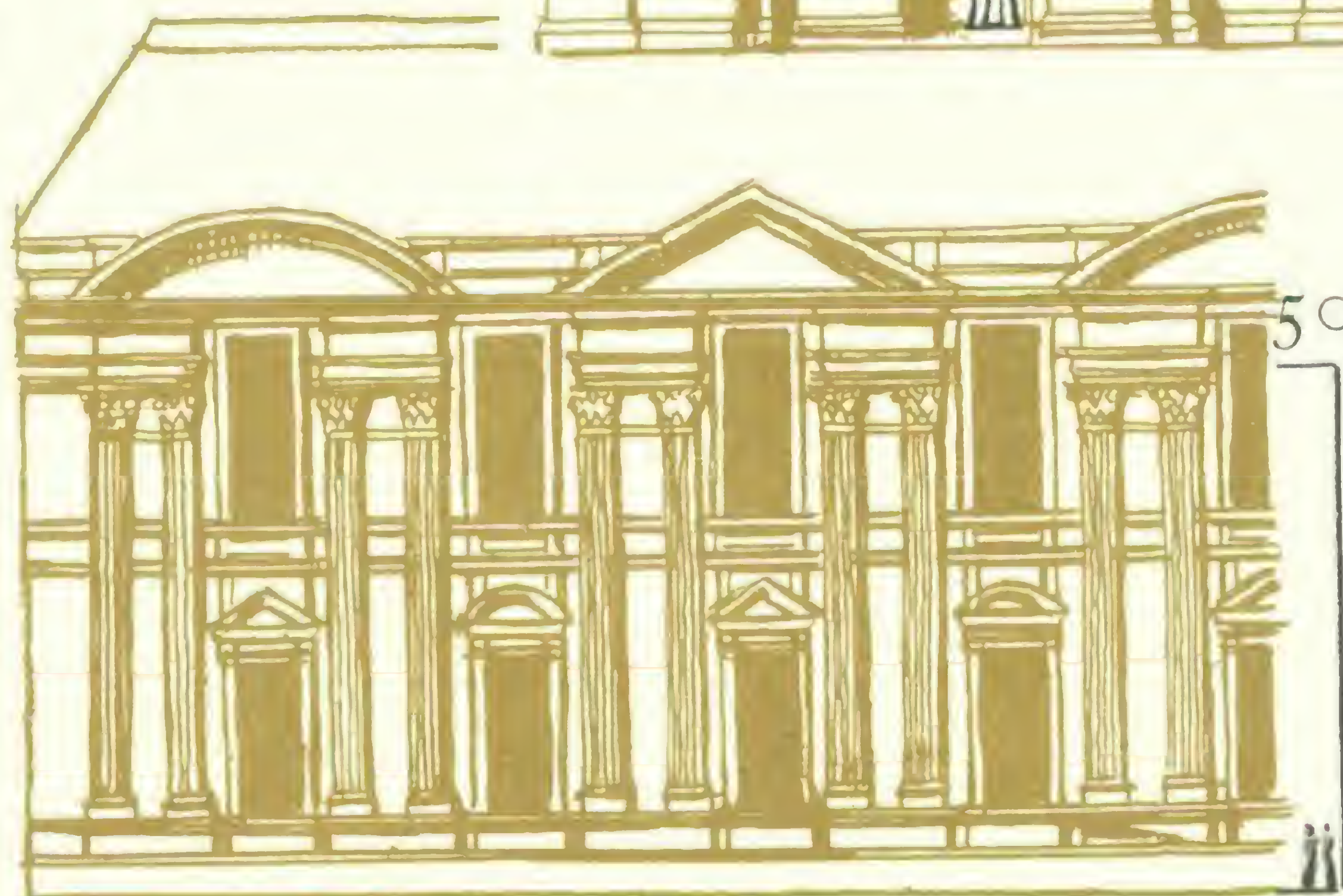
90



Château de Maisons,  
1642-46  
*François Mansart*  
(1598-1666)

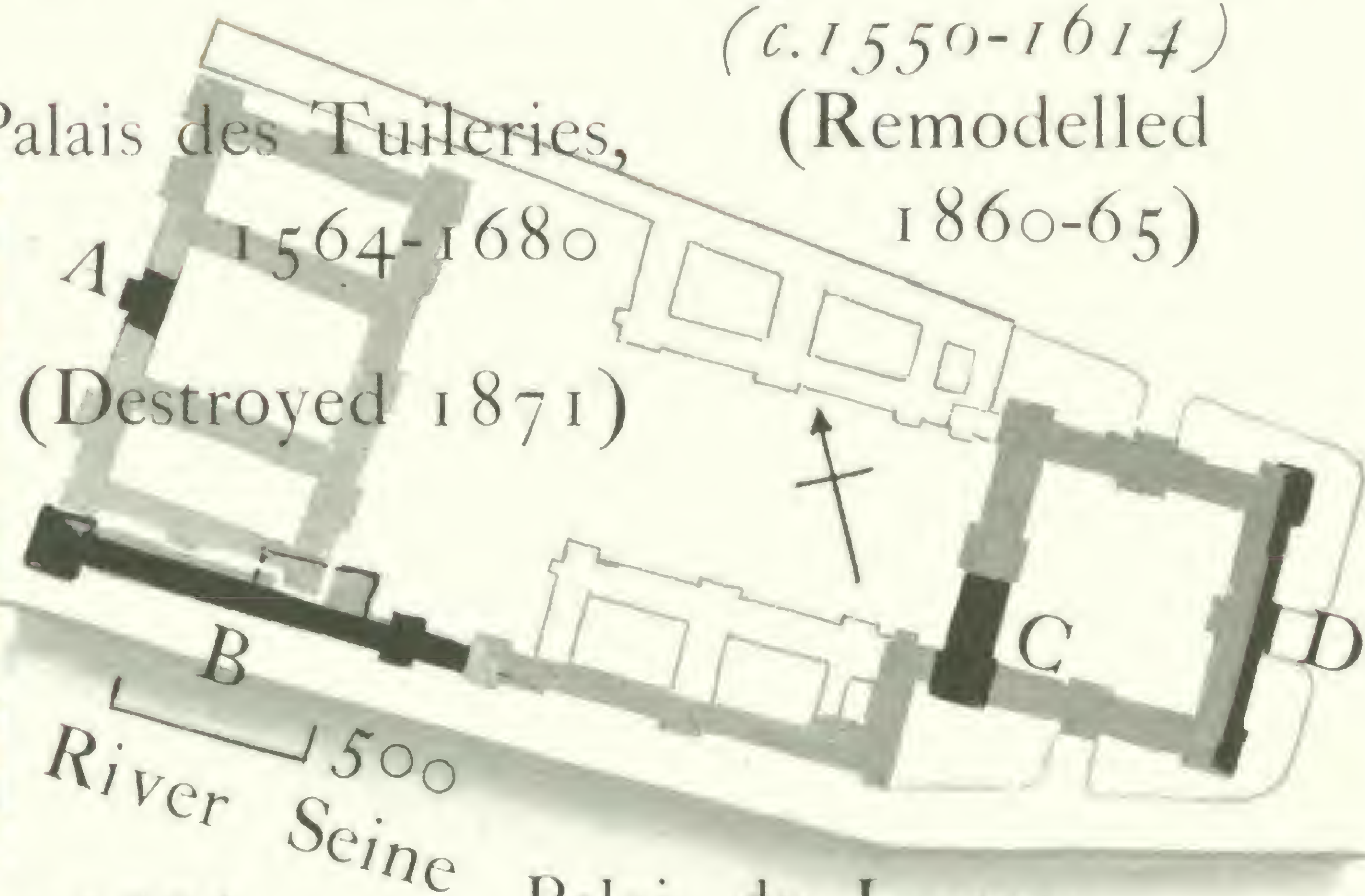


*Leonardo da Vinci*

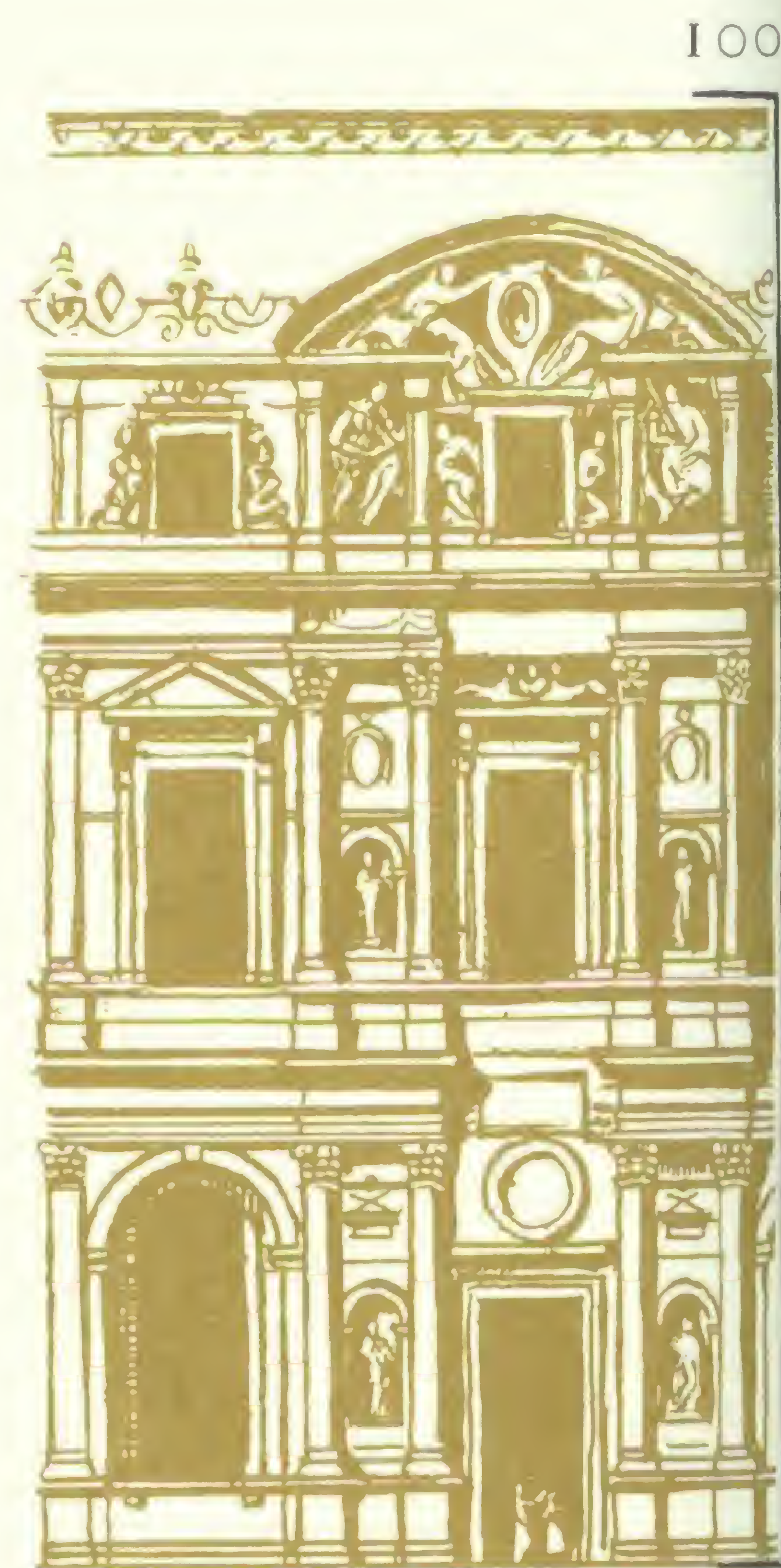


B. 1600-09 *Jacques du Cerceau*  
(c.1550-1614)  
(Remodelled 1860-65)

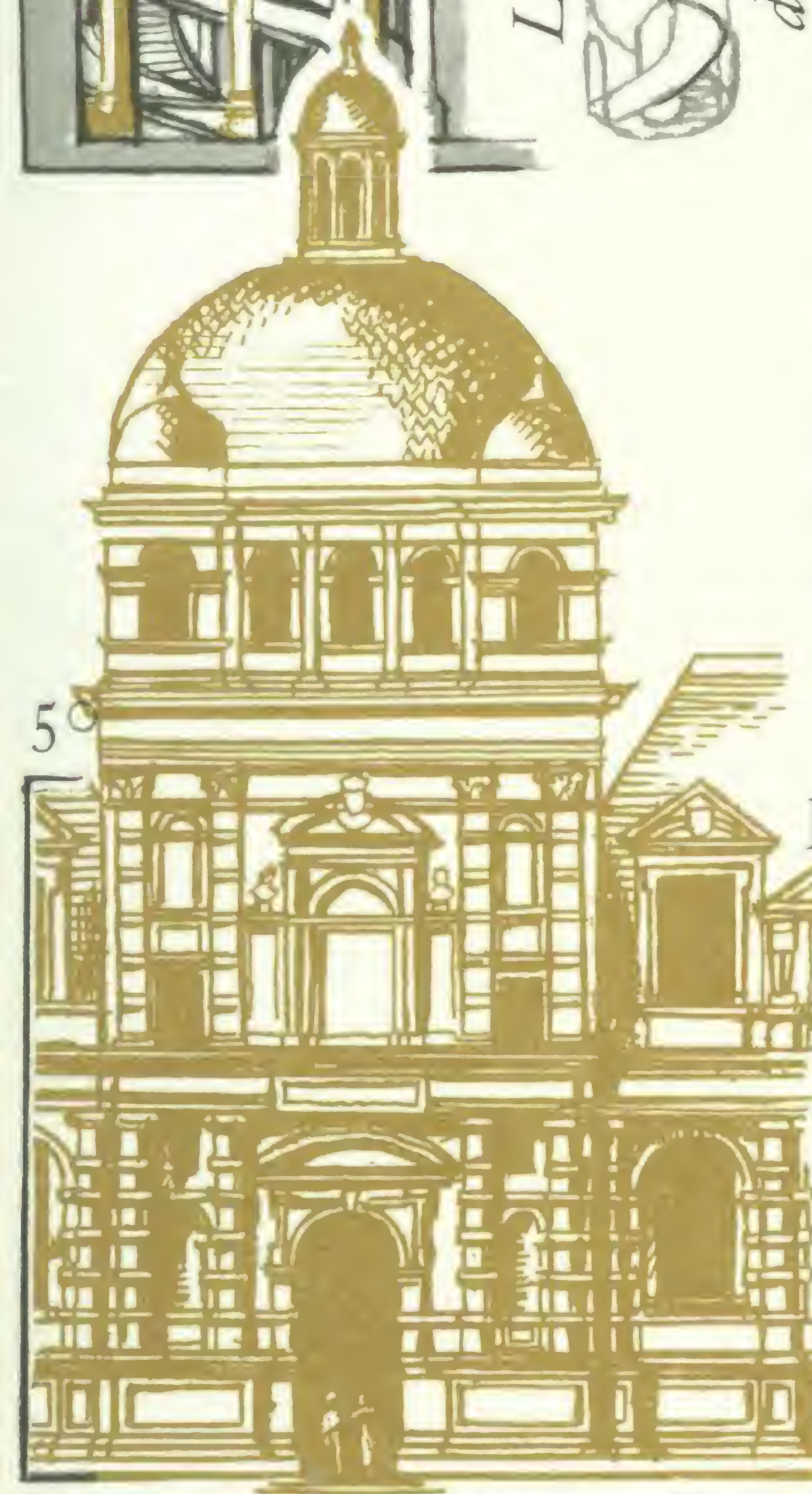
Palais des Tuileries,  
A. 1564-1680  
(Destroyed 1871)



Palais du Louvre,  
Paris, 1546-1878



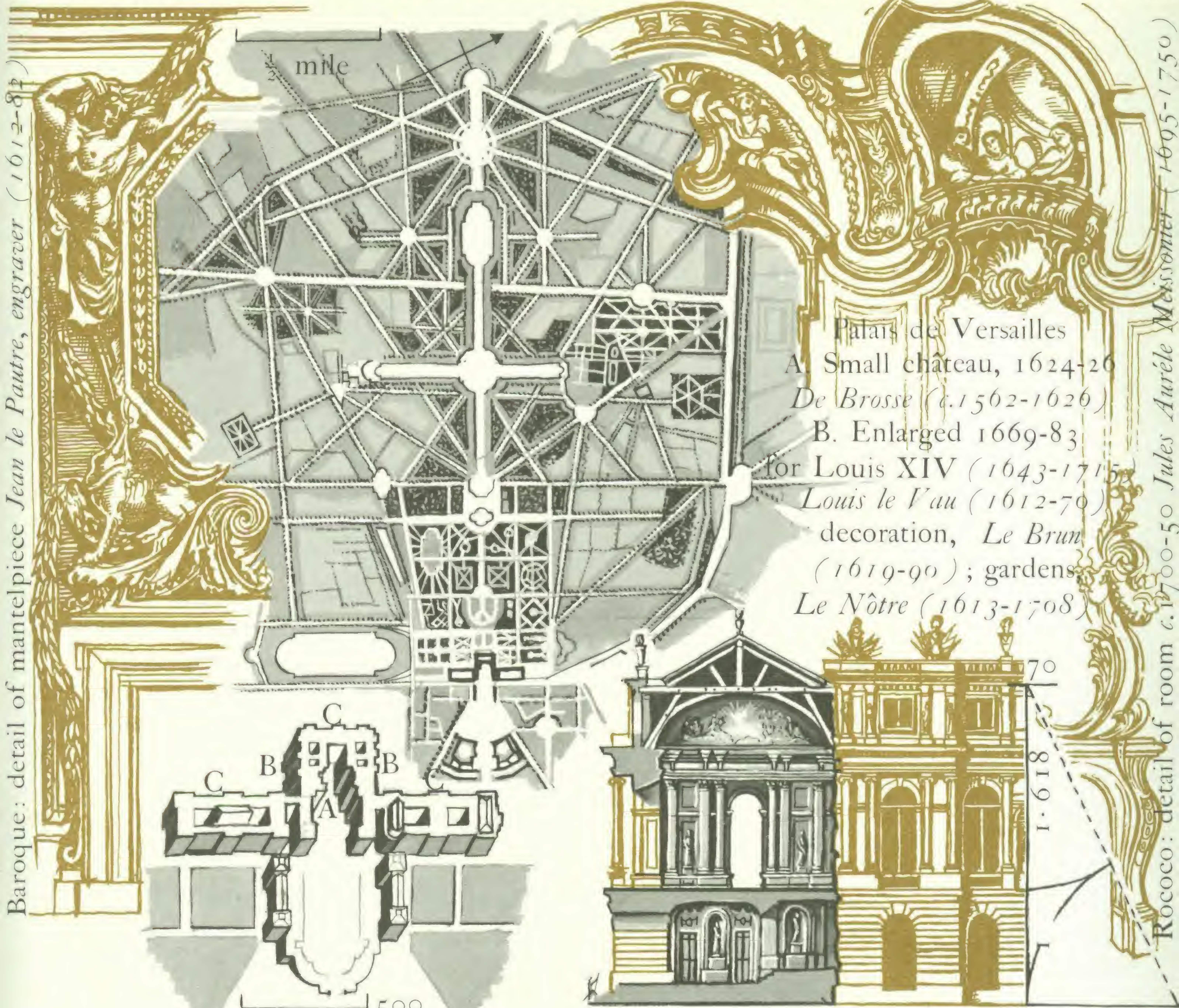
C. Course du Vieux Louvre, begun 1546  
*Pierre Lescot* (c.1510-78)



A. Central pavilion, 1570-1592  
*Philibert de l'Orme* (c.1515-1570)



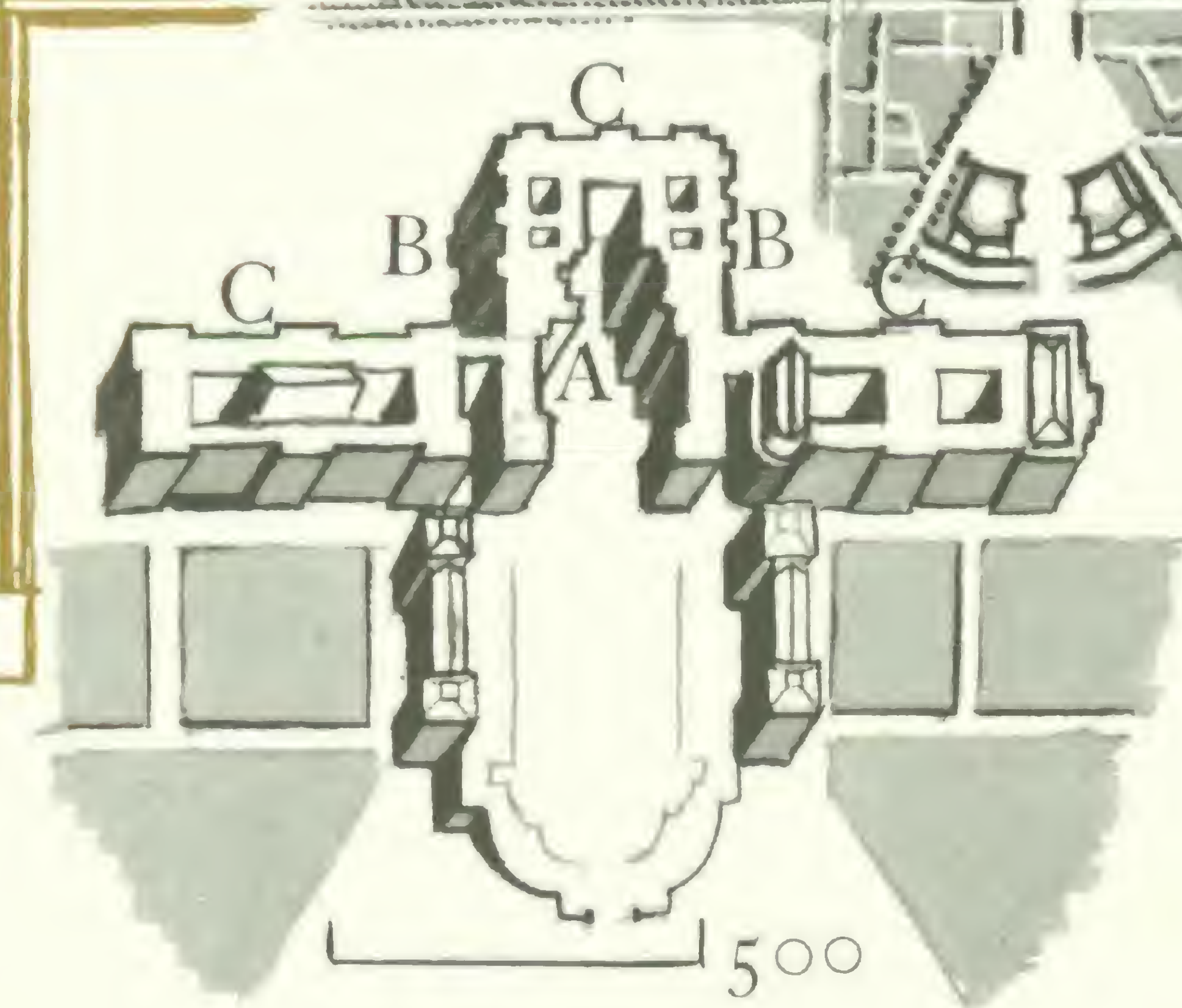
# FRANCE, CHÂTEAU TO PALACE



Baroque: detail of mantelpiece Jean le Pautre, engraver (1612-84)

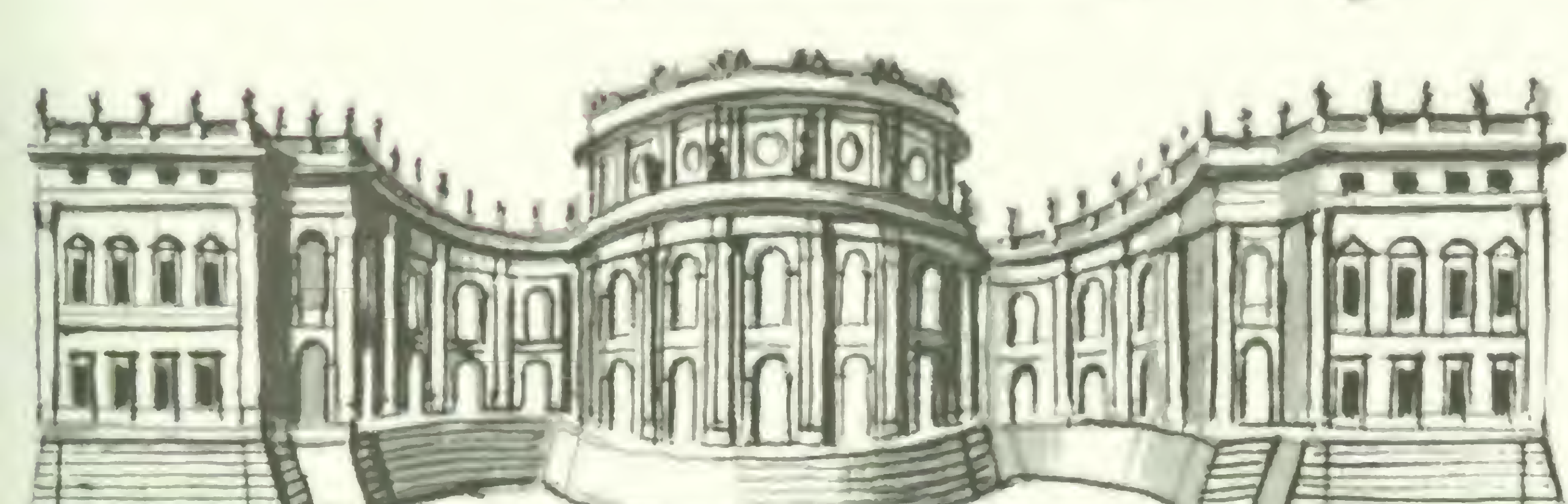
Rococo: detail of room c.1700-50 Jules Aurèle Meissonnier (1695-1750)

Palais de Versailles  
 A. Small chateau, 1624-26  
*De Brosse* (c.1562-1626)  
 B. Enlarged 1669-83  
 for Louis XIV (1643-1715)  
*Louis le Vau* (1612-70)  
 decoration, *Le Brun*  
 (1619-90); gardens  
*Le Nôtre* (1613-1708)

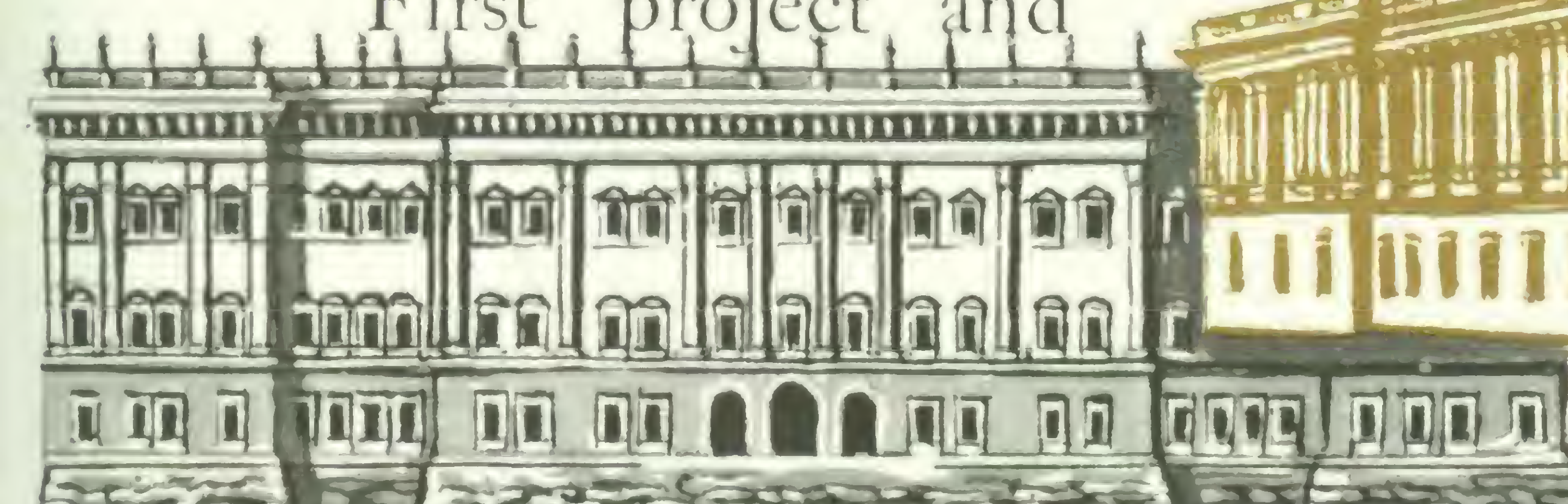


C. Galerie des Glaces, & Façade  
 1679-82 *J. H. Mansart*  
 (1646-1708)

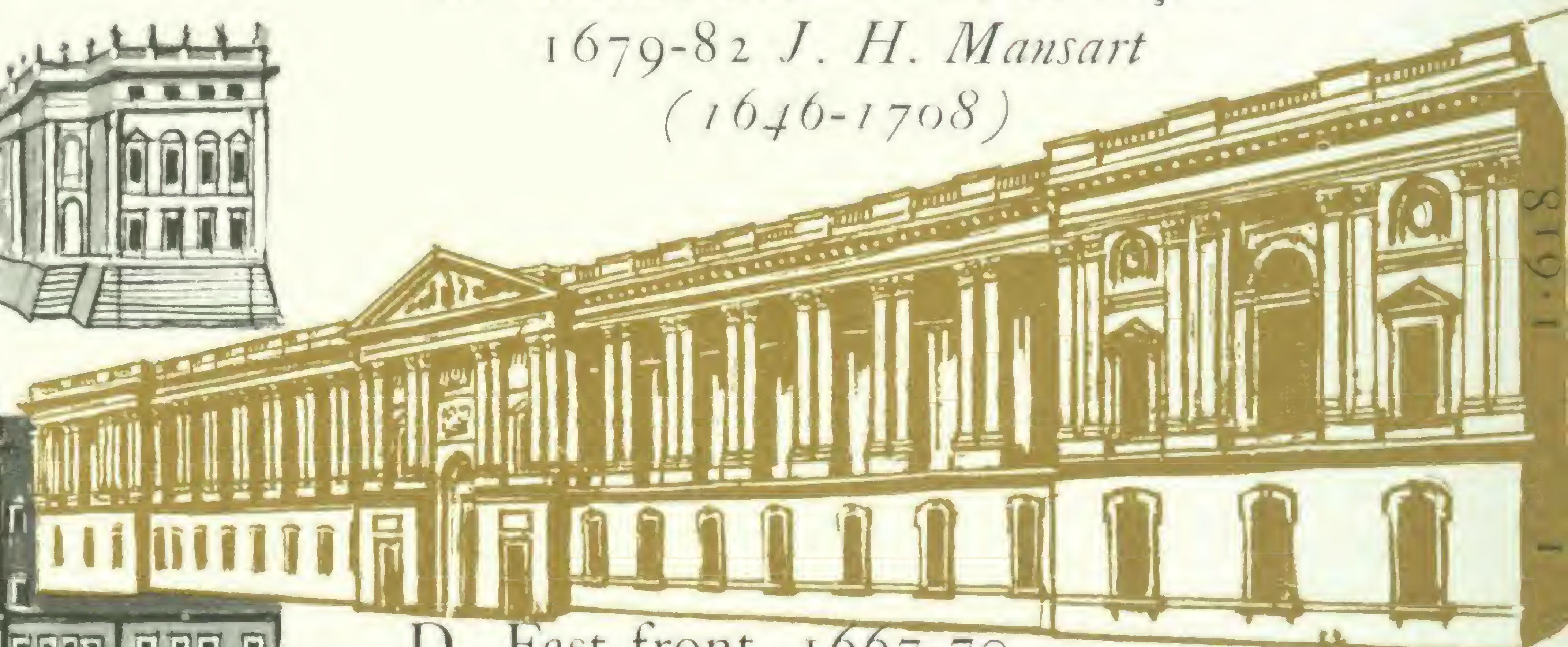
95



First project and



final project made by *Bernini* (1598-1680)  
 in Paris, 1665 for the East Front of the Louvre



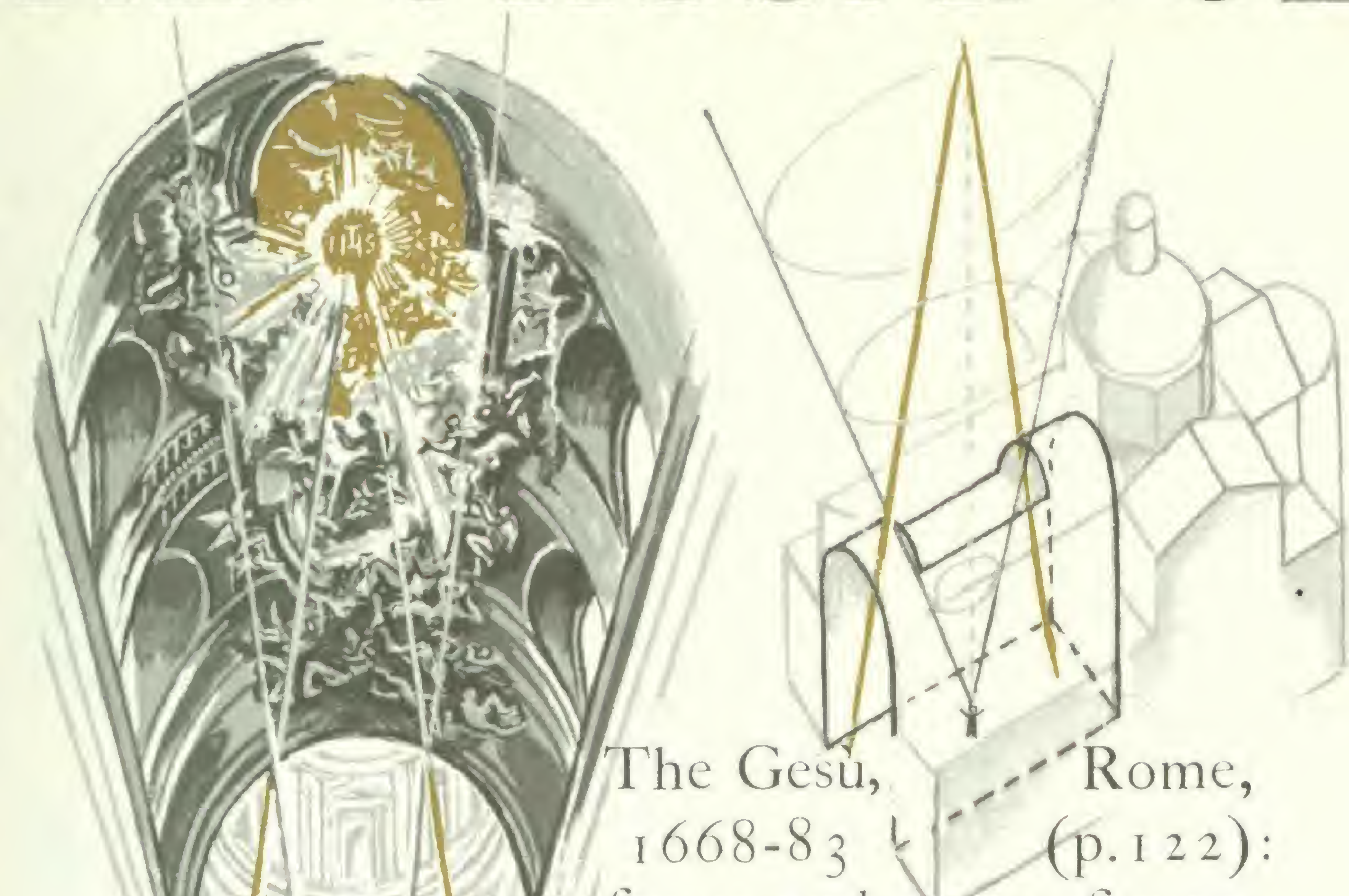
D. East front, 1667-70

*Claude Perrault* (1613-88),  
*Louis Le Vau* (1612-88) &  
*Charles Le Brun* (1619-90)

1.618

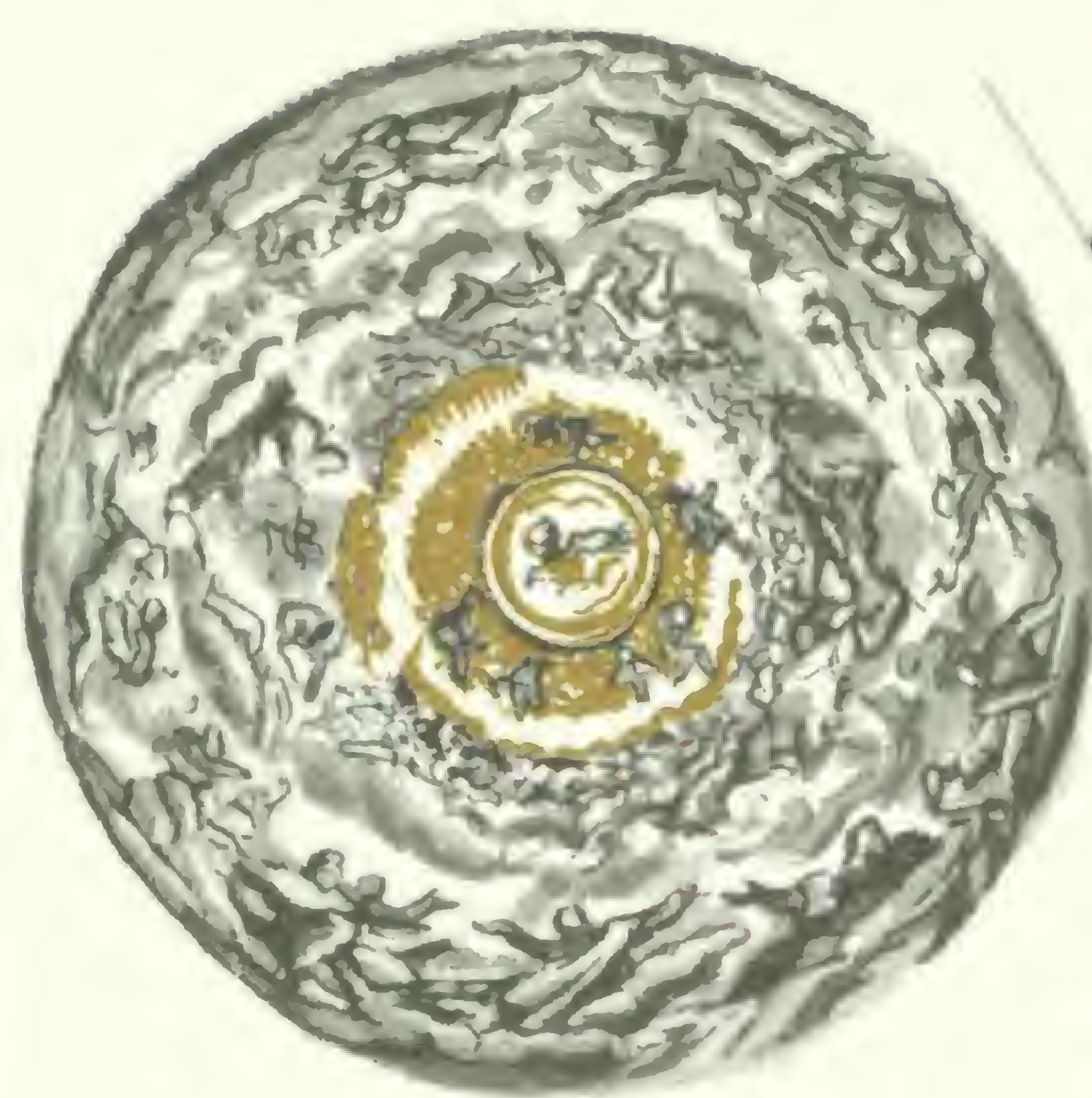


# RENAISSANCE-BAROQUE



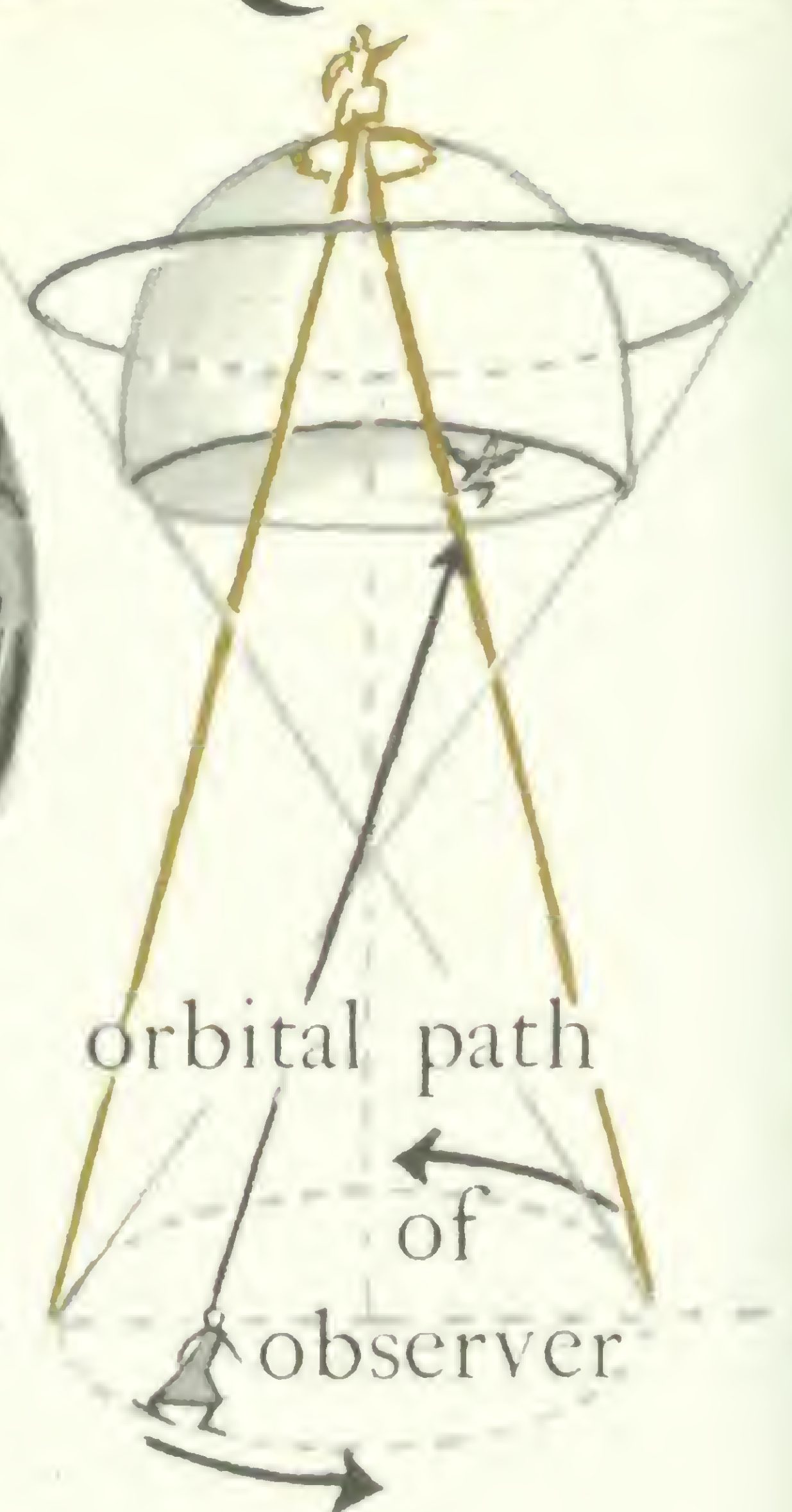
The Gesù, Rome,  
1668-83 (p.122):  
fresco and stucco figures  
on nave vault, 1674-79,

'Adoration of the Name of Jesus'  
*Giovanni Battista Gaulli (1639-1709)*



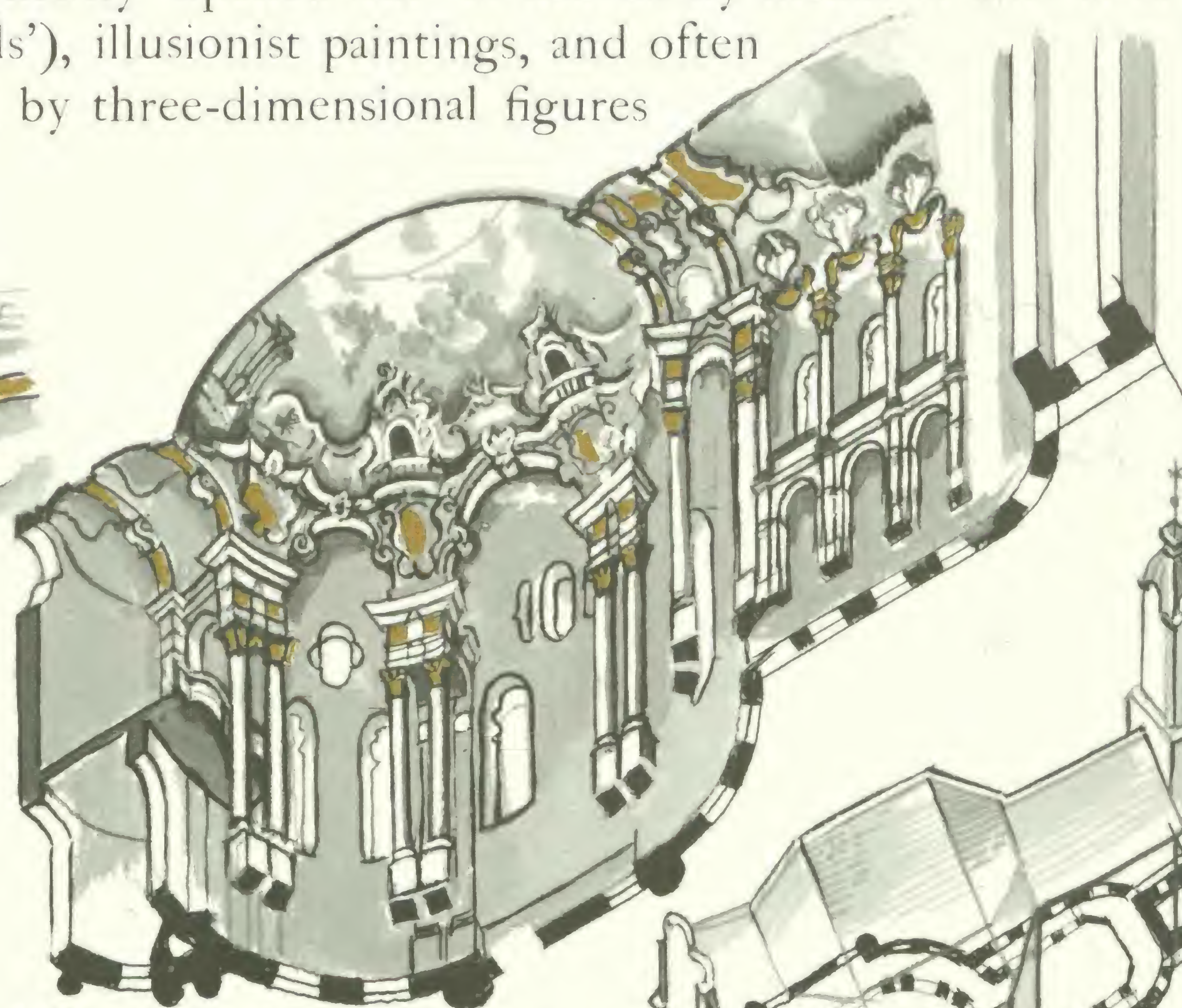
S. Andrea in Valle,  
Rome, 1591-1623:  
fresco in dome,  
'The Virgin in Glory'

*Giovanni Lanfranco (1582-1647)*

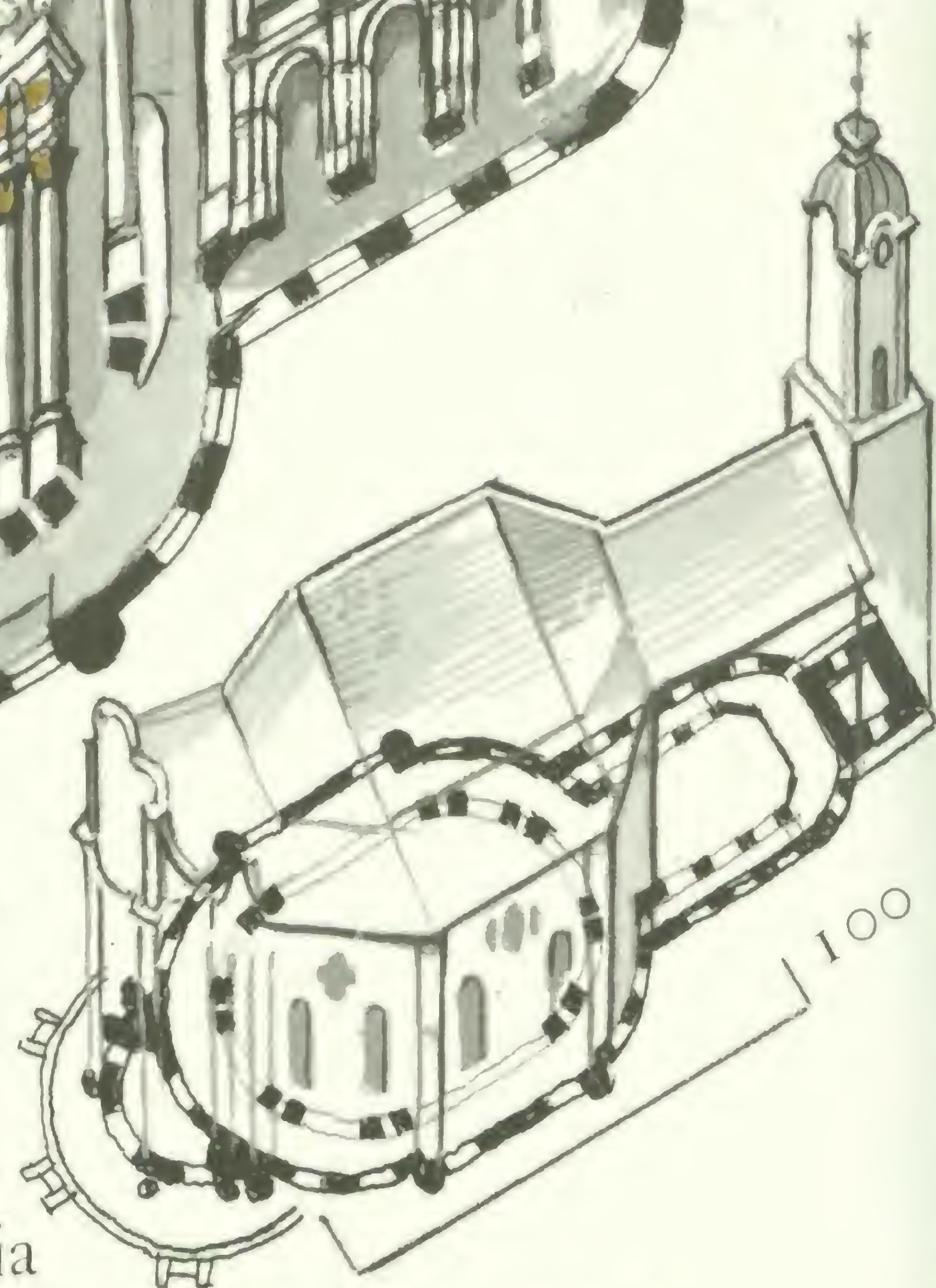


## Italian Baroque churches

Vaults, domes and apses were frequently 'opened out' to heaven by means of *sotto in su* (Italian: 'from below upwards'), illusionist paintings, and often reinforced by three-dimensional figures



Die Wies, Southern Germany,  
1745-54  
*Dominikus Zimmermann*  
(1685-1766)

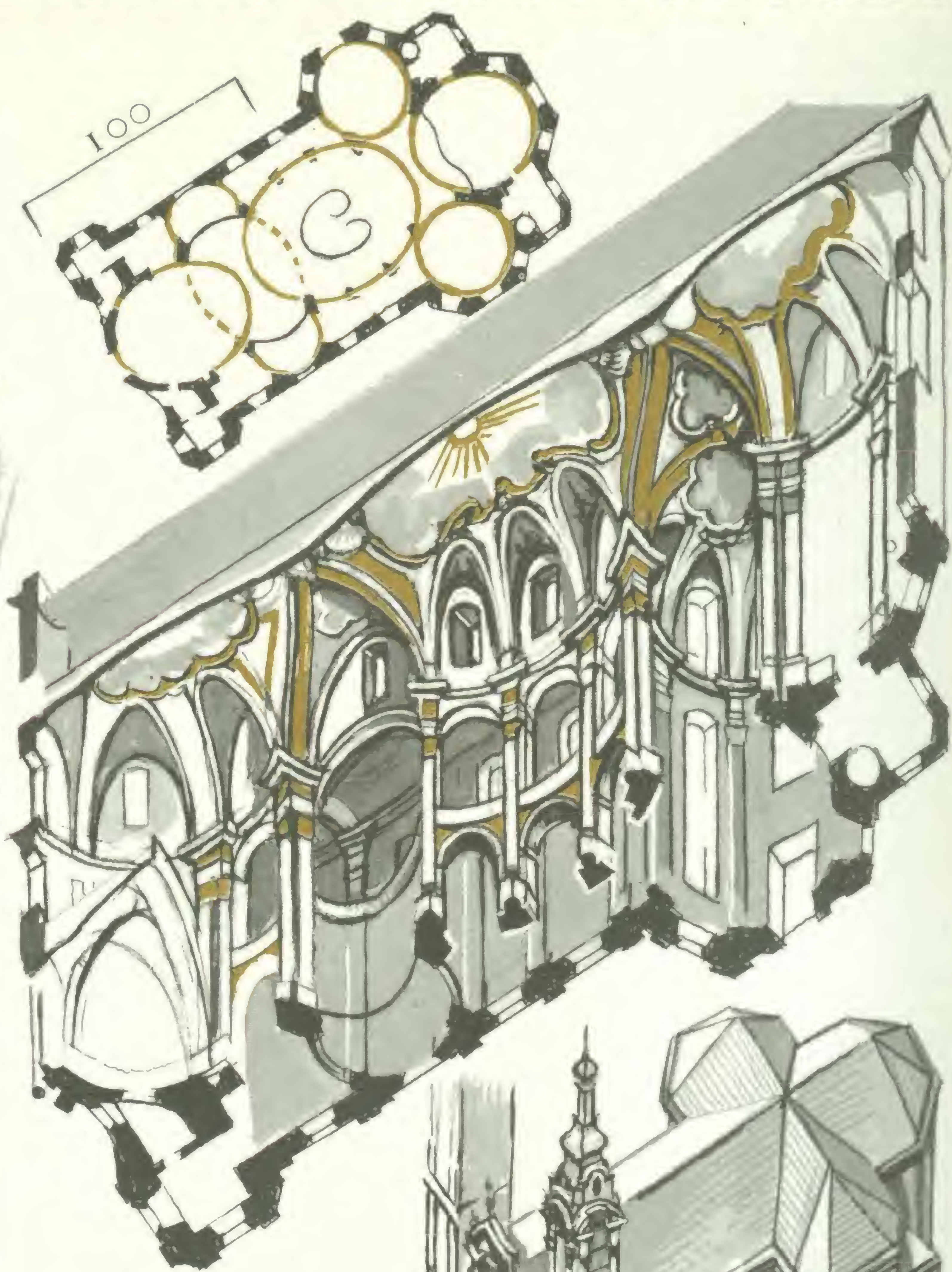


In Southern Germany and Austria many Jesuit Baroque churches were built in the style of the Gesù (p.122).

The 'Thirty Years' War (1618-48) was followed by a resurgence of church-building in which all the arts—architecture, sculpture, painting and music—were fused into Rococo.

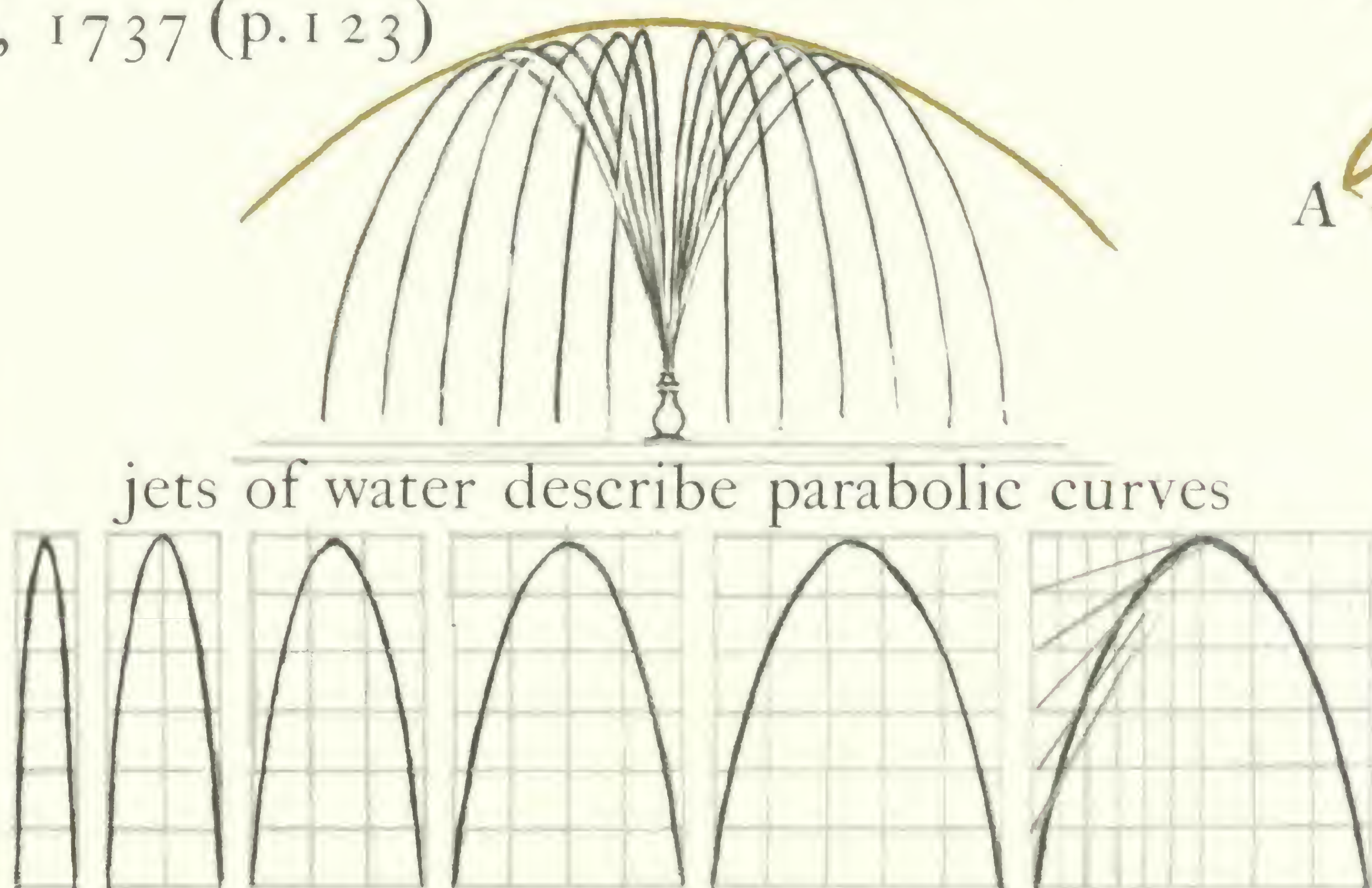
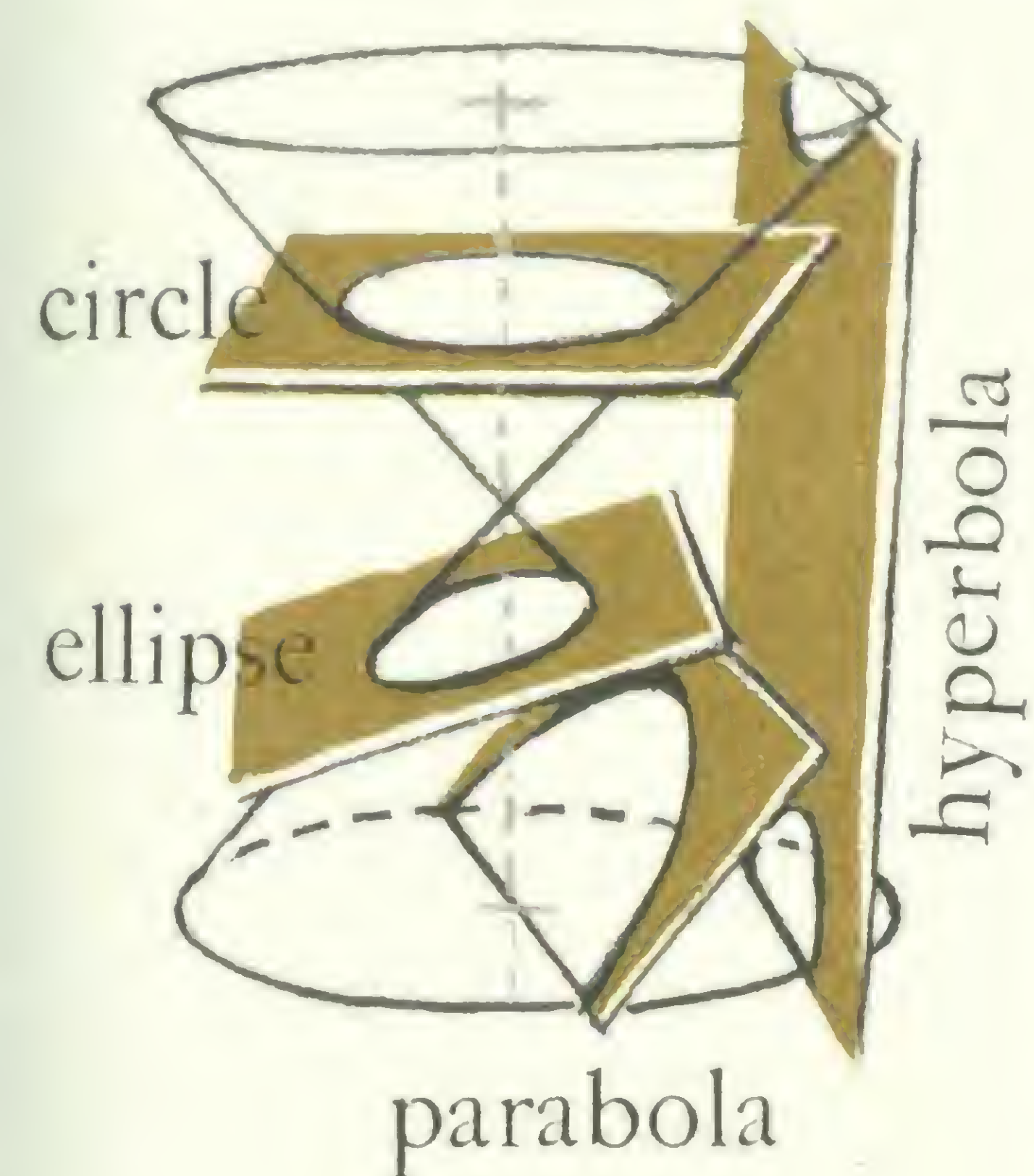
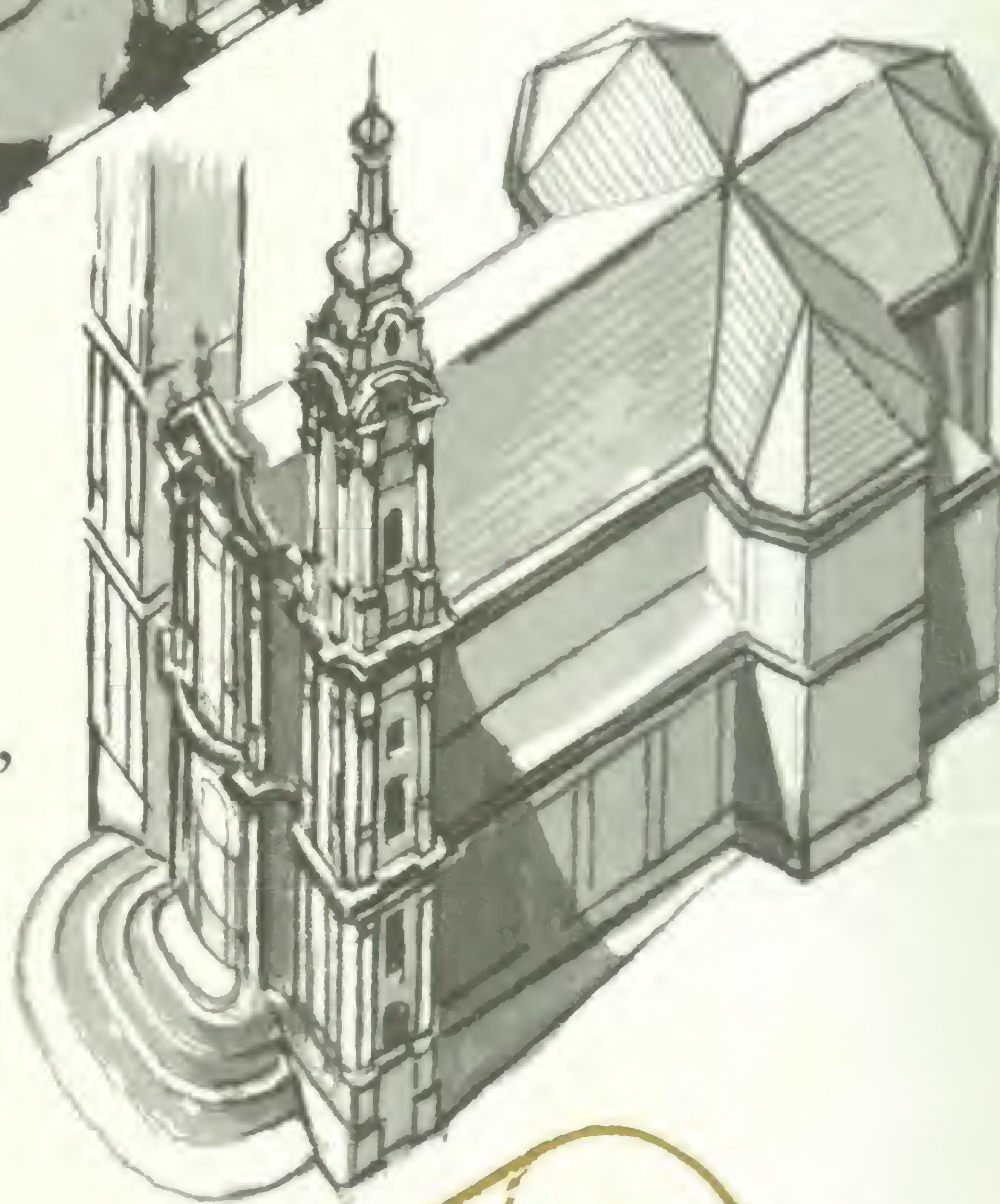


# GERMANY, ROCOCO CHURCHES

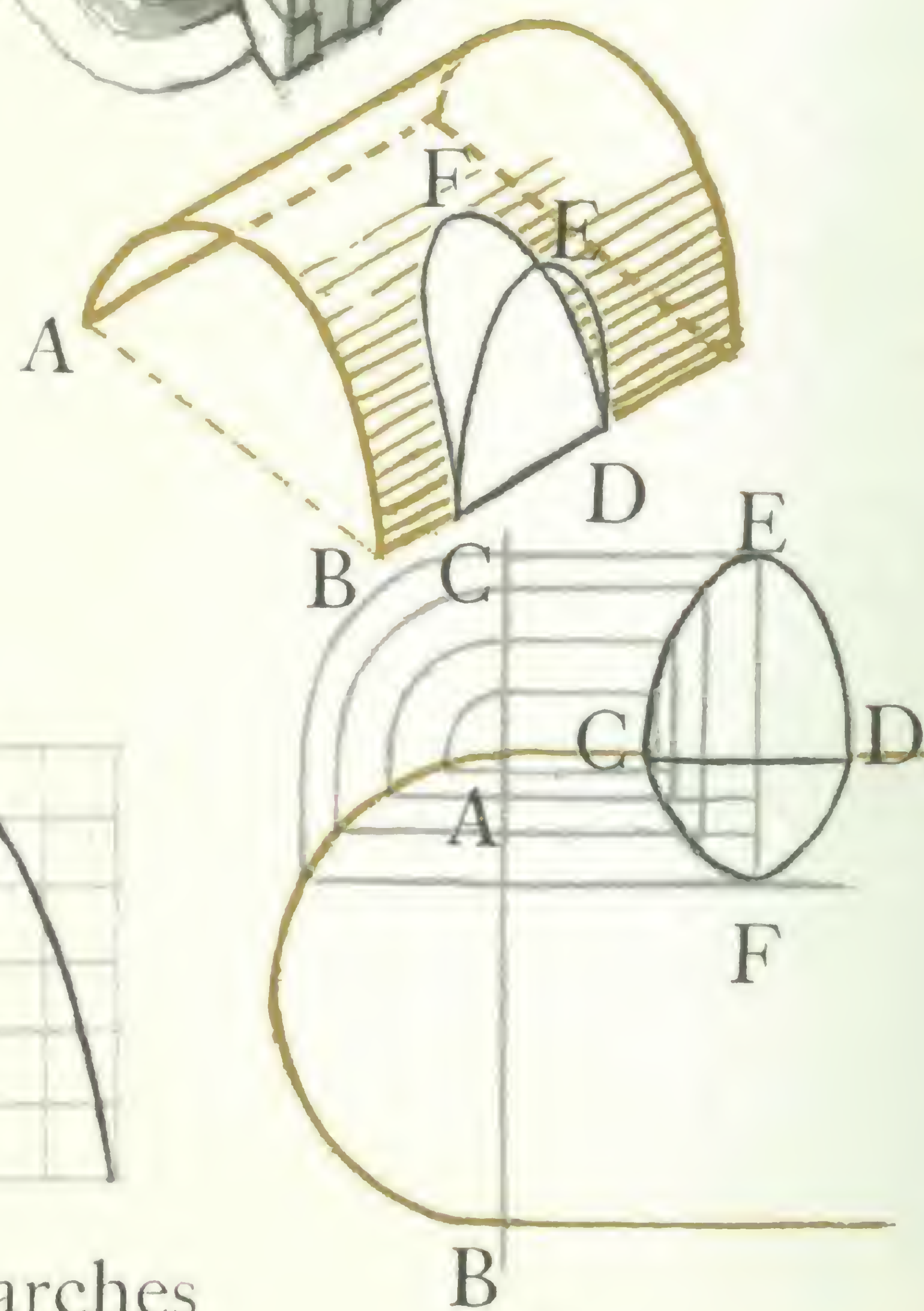


Vierzehnheiligen, Southern Germany,  
1744-72

Balthasar Neumann (1687-1753),  
architect, mathematician, military engineer, town-planner,  
designer of fountains, bell-caster; possessed Guarini's  
*dell' Architettura Civile*, 1737 (p.123)



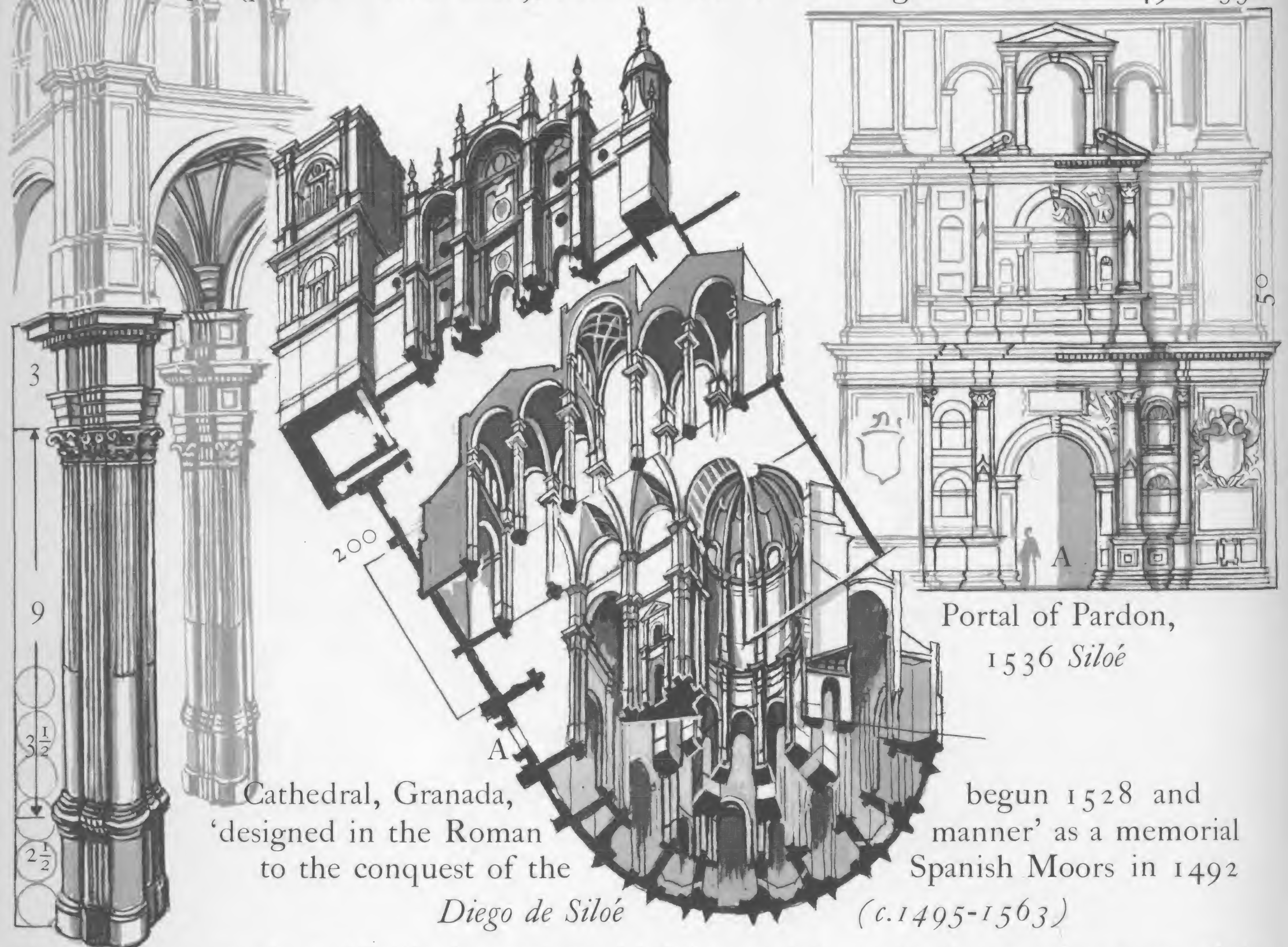
parabolic, forward tilted, three-dimensional arches



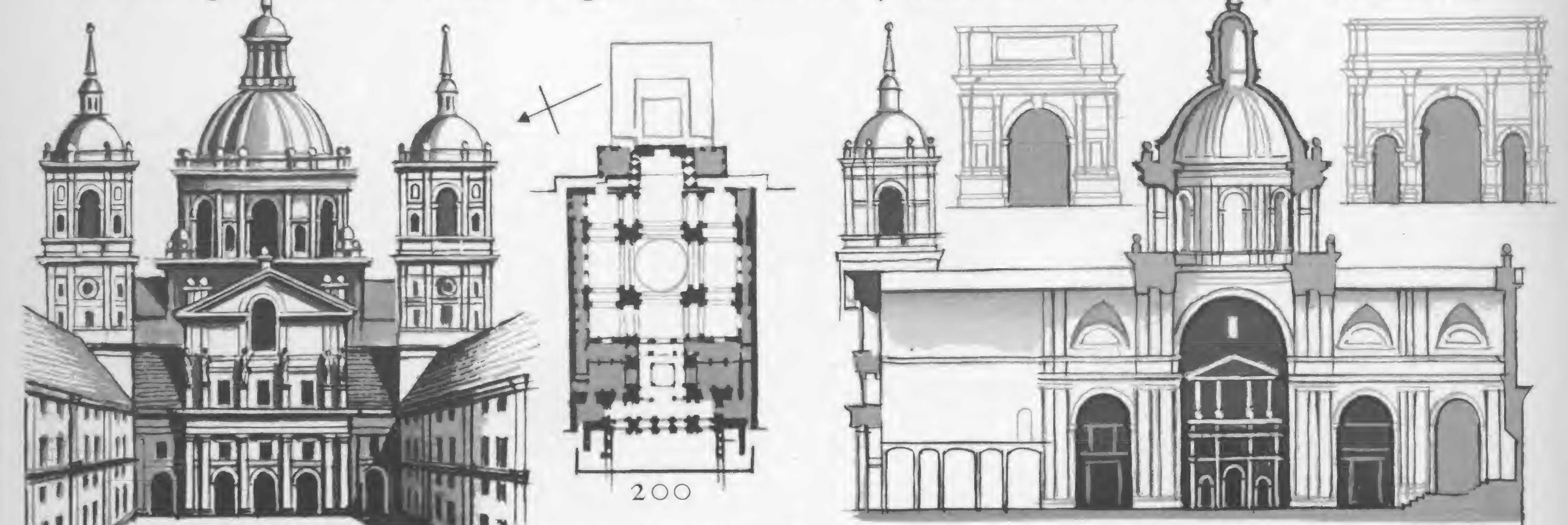


# RENAISSANCE-BAROQUE

I 'Plateresque' (*platero* = silversmith), from the use of extravagant decoration 1492-1556



II Herreran style or '*Estilo desornamentado*' (plain style), 1556-1650: adaptation of the design of the Italian High Renaissance by *Juan de Herrera* (c.1530-97)



The Escorial 1574-82 (p.115), Doric Church, first designed by Juan Bautista de Toledo (d.1567), philosopher and mathematician, who worked under Michelangelo; redesigned by *Juan de Herrera* (c.1530-97) built in yellow-grey granite, in 2:3 ratios



## III 'Churrigueresque', named after *José de Churriguera* (1665-1723)

Cathedral,  
Santiago  
de Compostella:  
west façade,  
known as  
'El Obradoiro',  
c.1738

*Fernando  
de Casas y Novoa*  
(fl. 1711-94)



Charterhouse sacristy, Granada, 1713-47.

Designed by *Francisco Hurtado* (1669-1725), begun 1730  
by *Luis de Arévalo* (1727-64), stonemason; plasterwork by *Luis Cabello*



# RENAISSANCE - BAROQUE



Pre-Fire Design for  
a domed crossing,  
'in a Latine style'  
1666



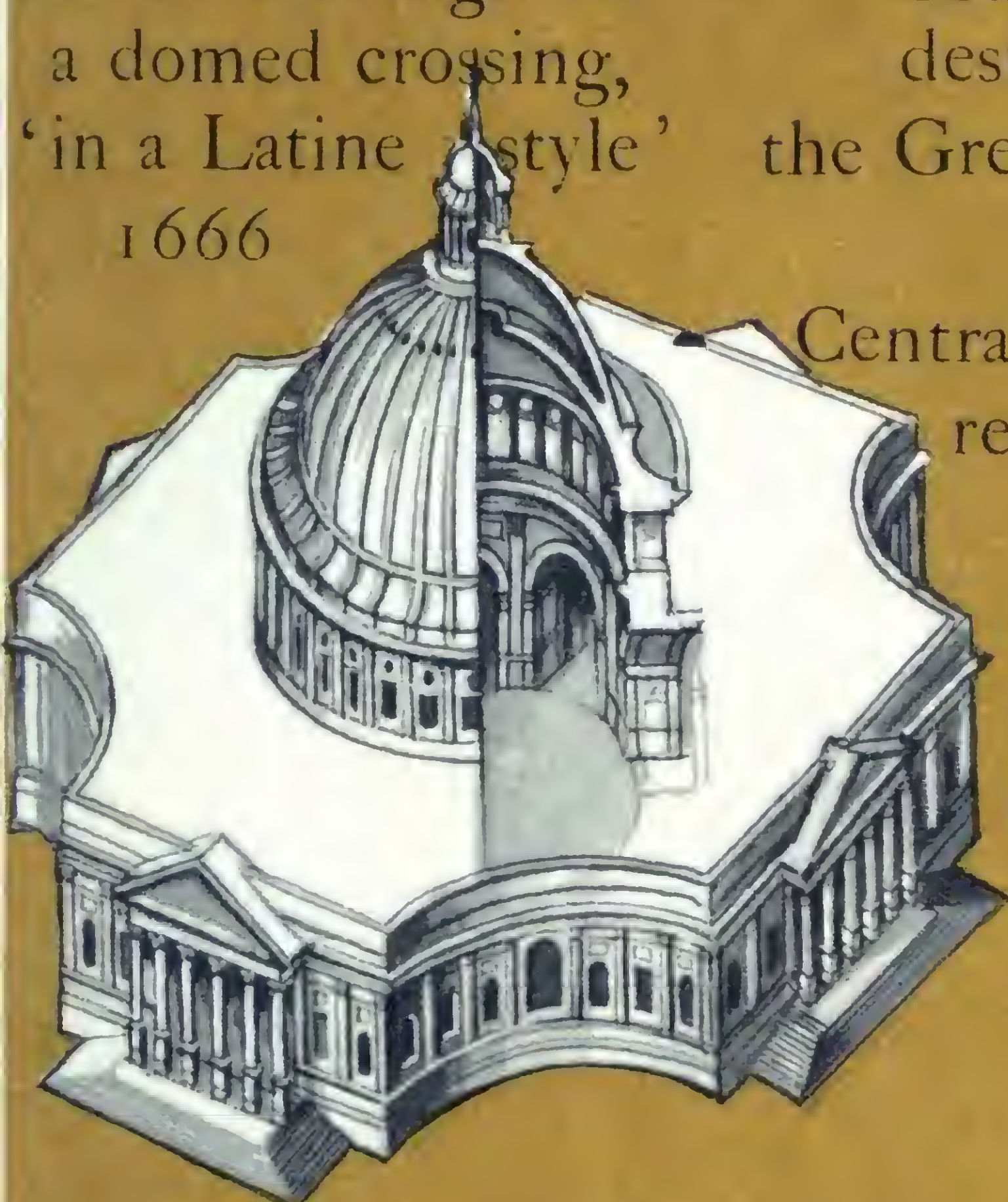
Old St Paul's,  
destroyed in  
the Great Fire, 1666



The Pantheon Design  
c. 1668-69



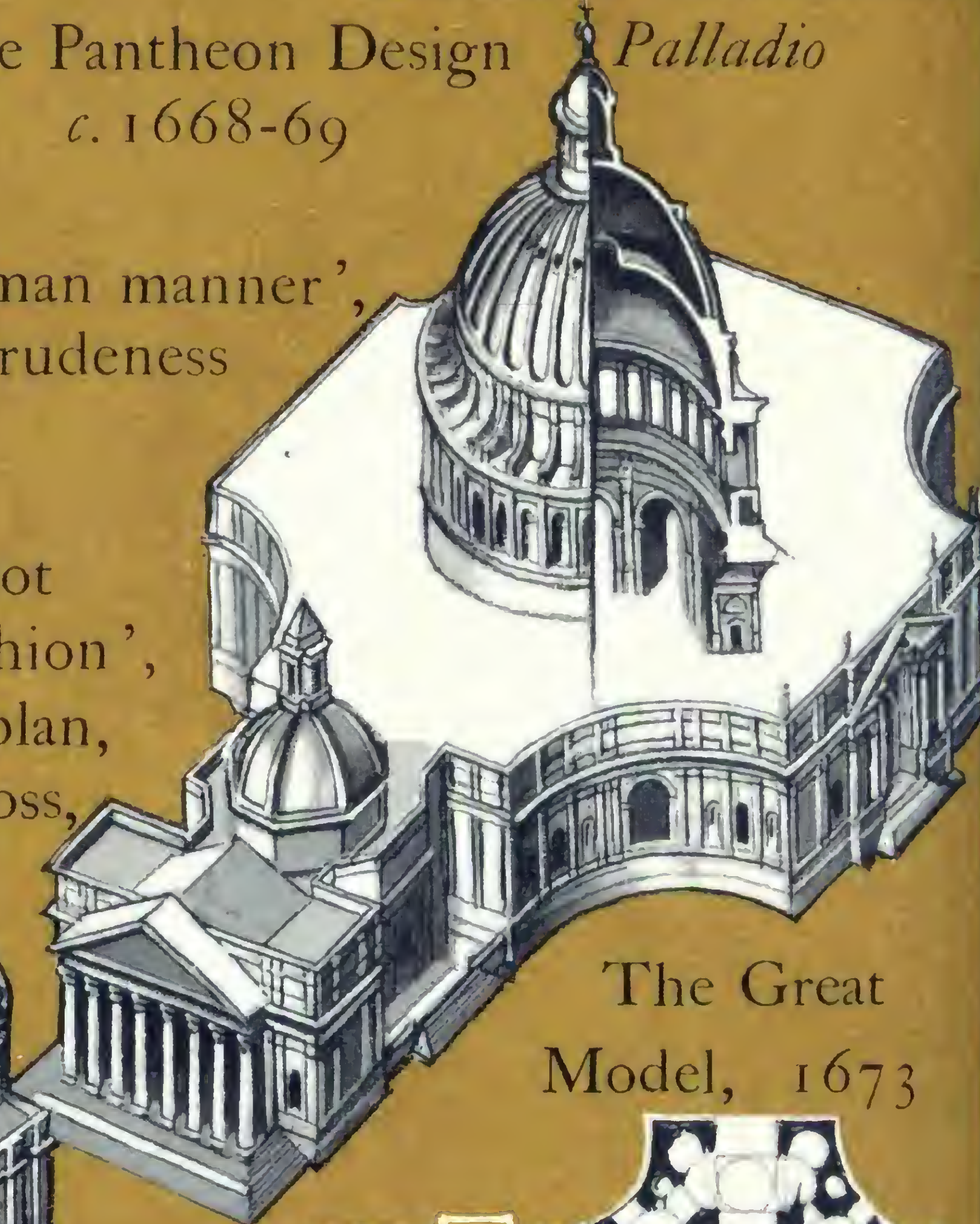
Basilica of Constantine  
*Palladio*



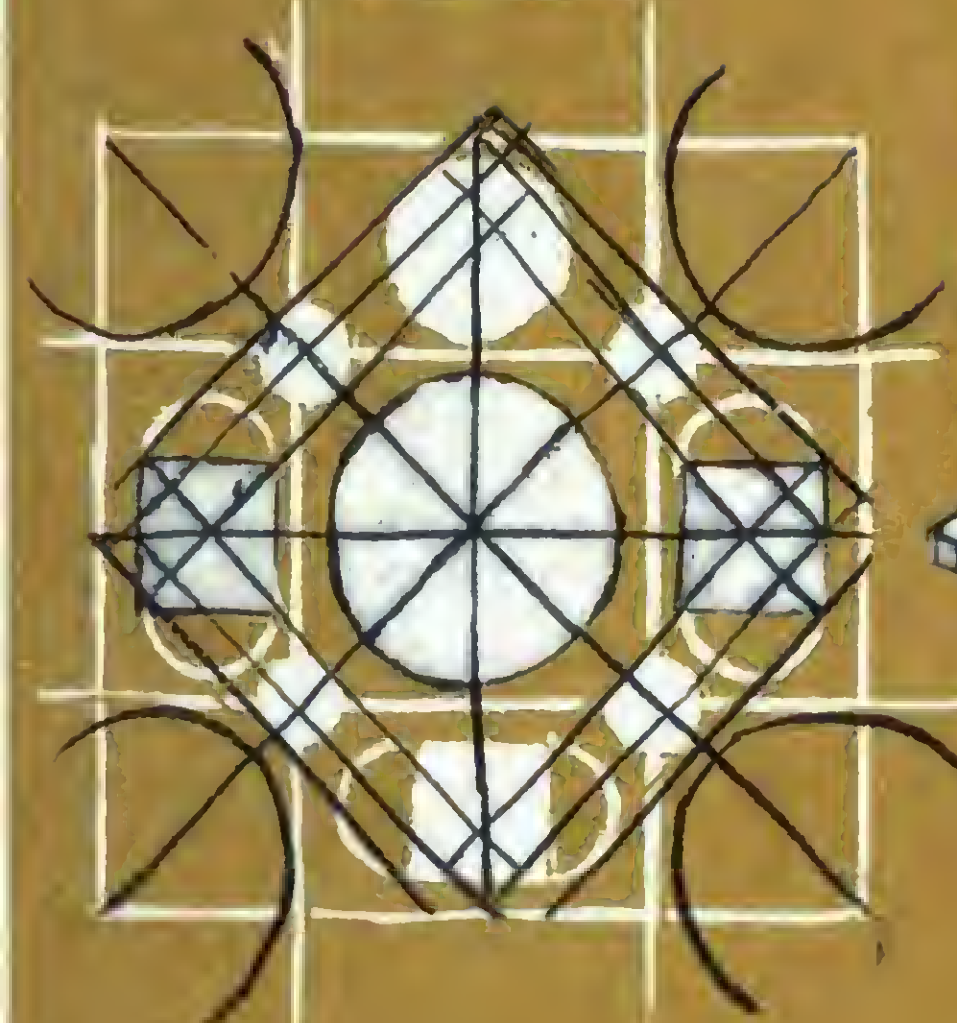
Greek Cross Design, c. 1672

Centralized designs 'after a Roman manner',  
remote from 'the Gothick rudeness  
of ye old Design'.

The chapter  
'thought the model not  
enough of a cathedral fashion',  
and a longitudinal plan,  
based on the Latin Cross,  
was adopted.



The Great  
Model, 1673

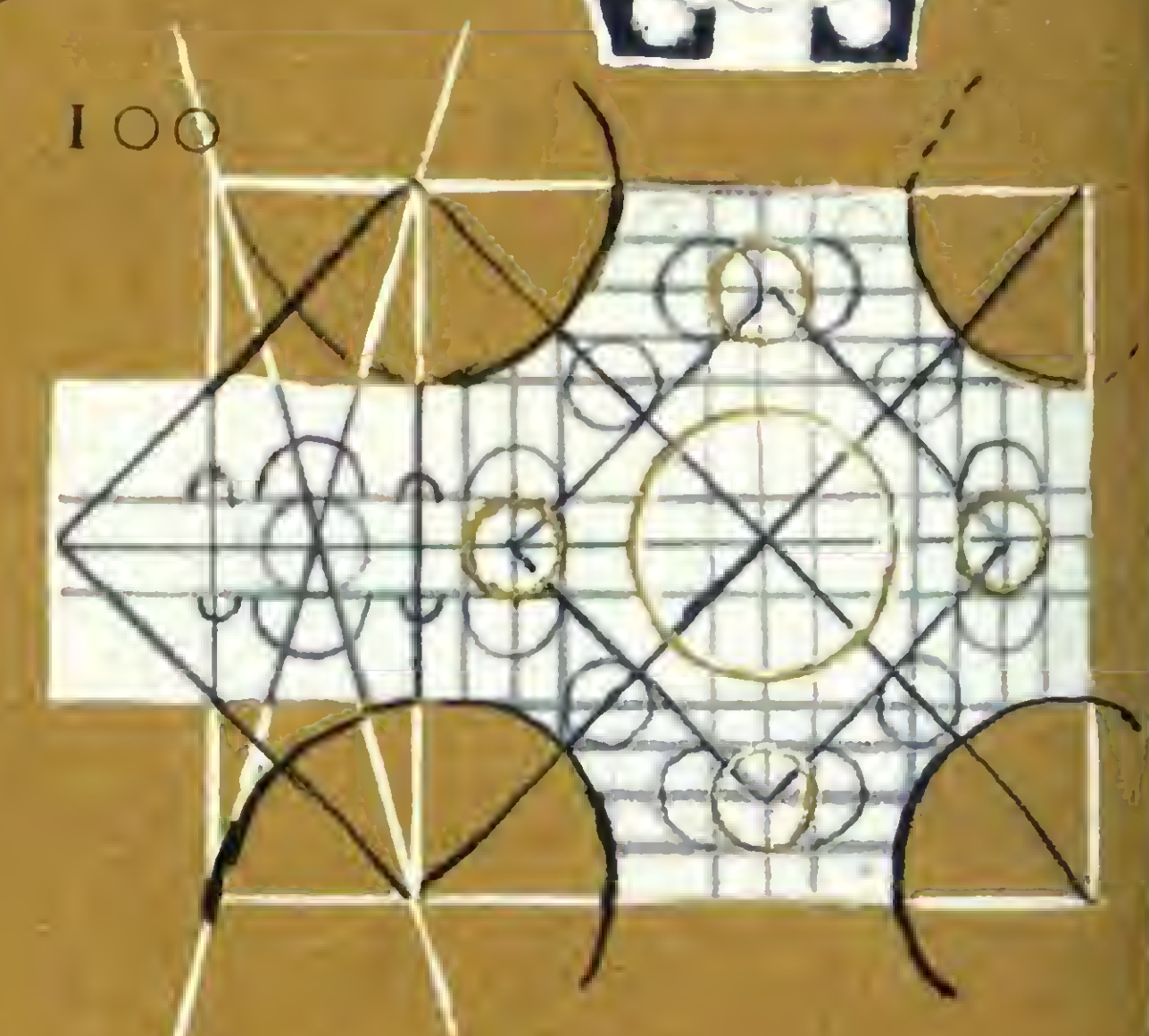


The Warrant Design, before 1675



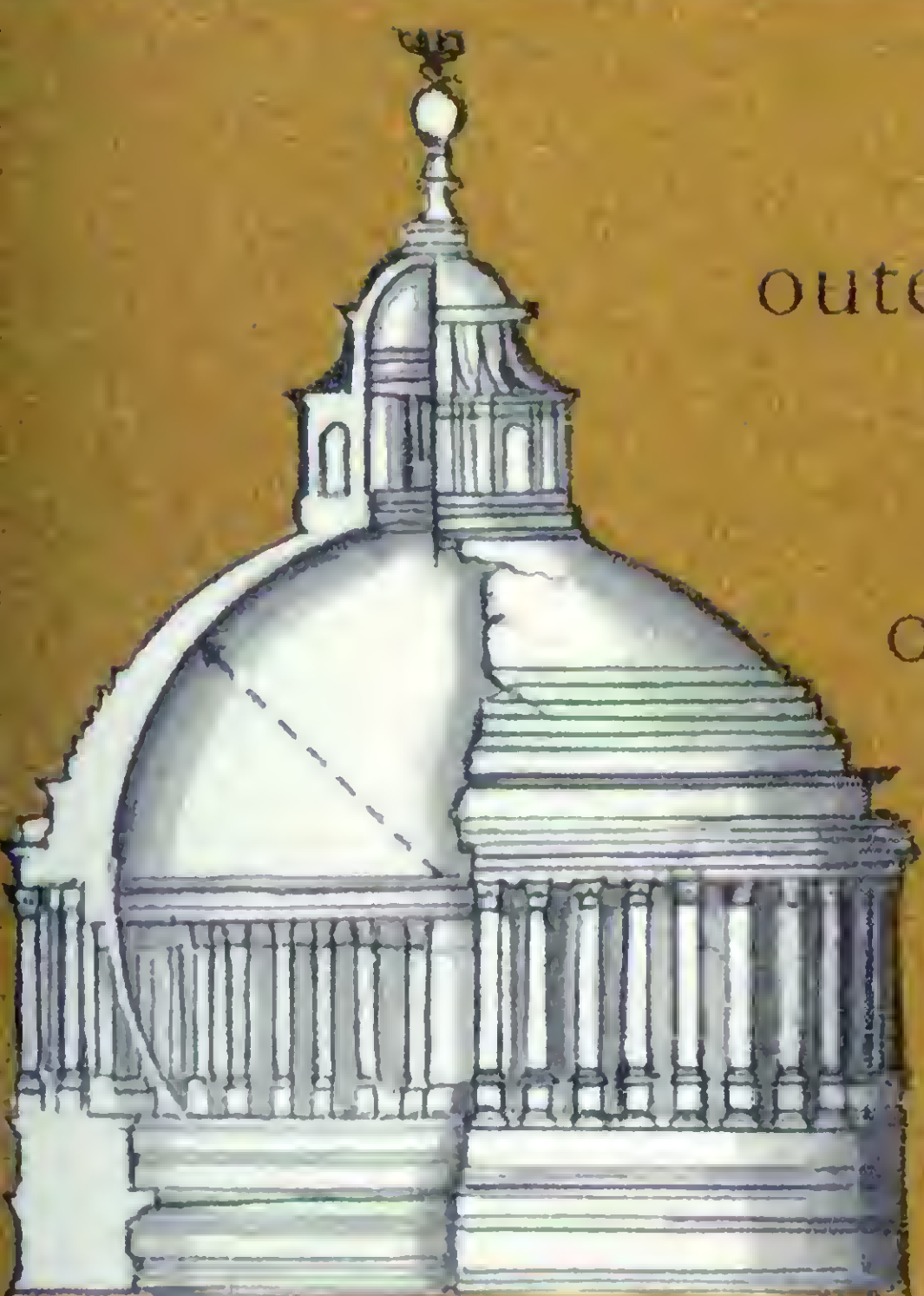
elevations

plans





# ENGLAND, WREN & THE BAROQUE

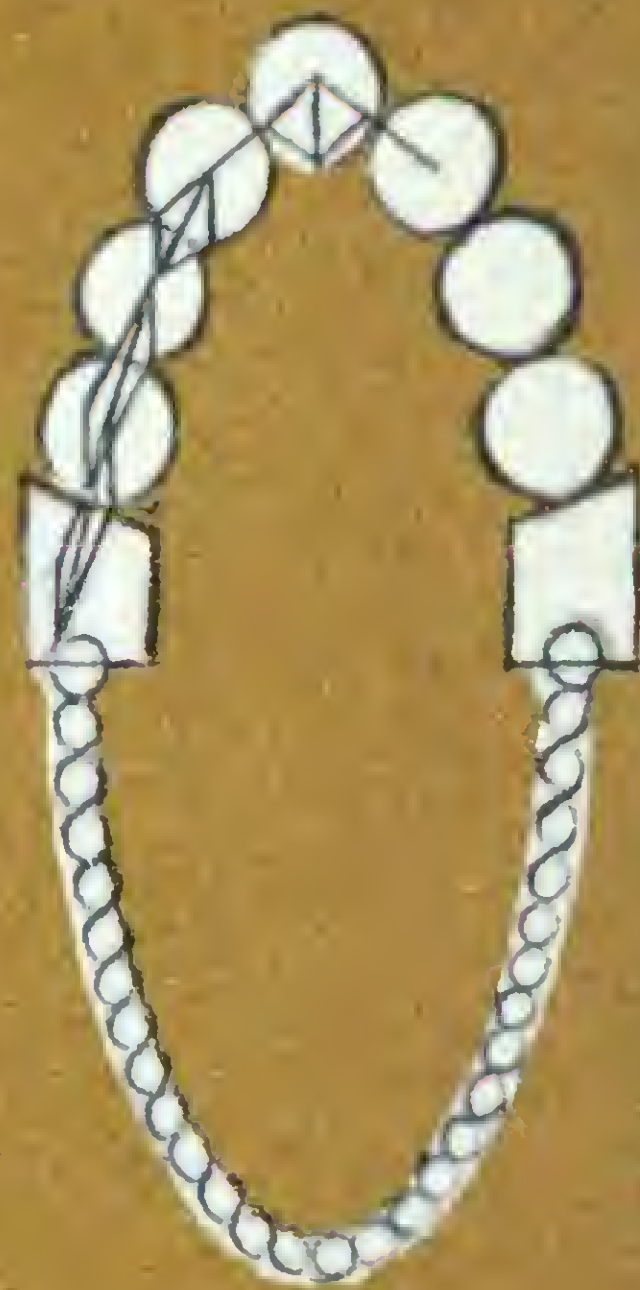
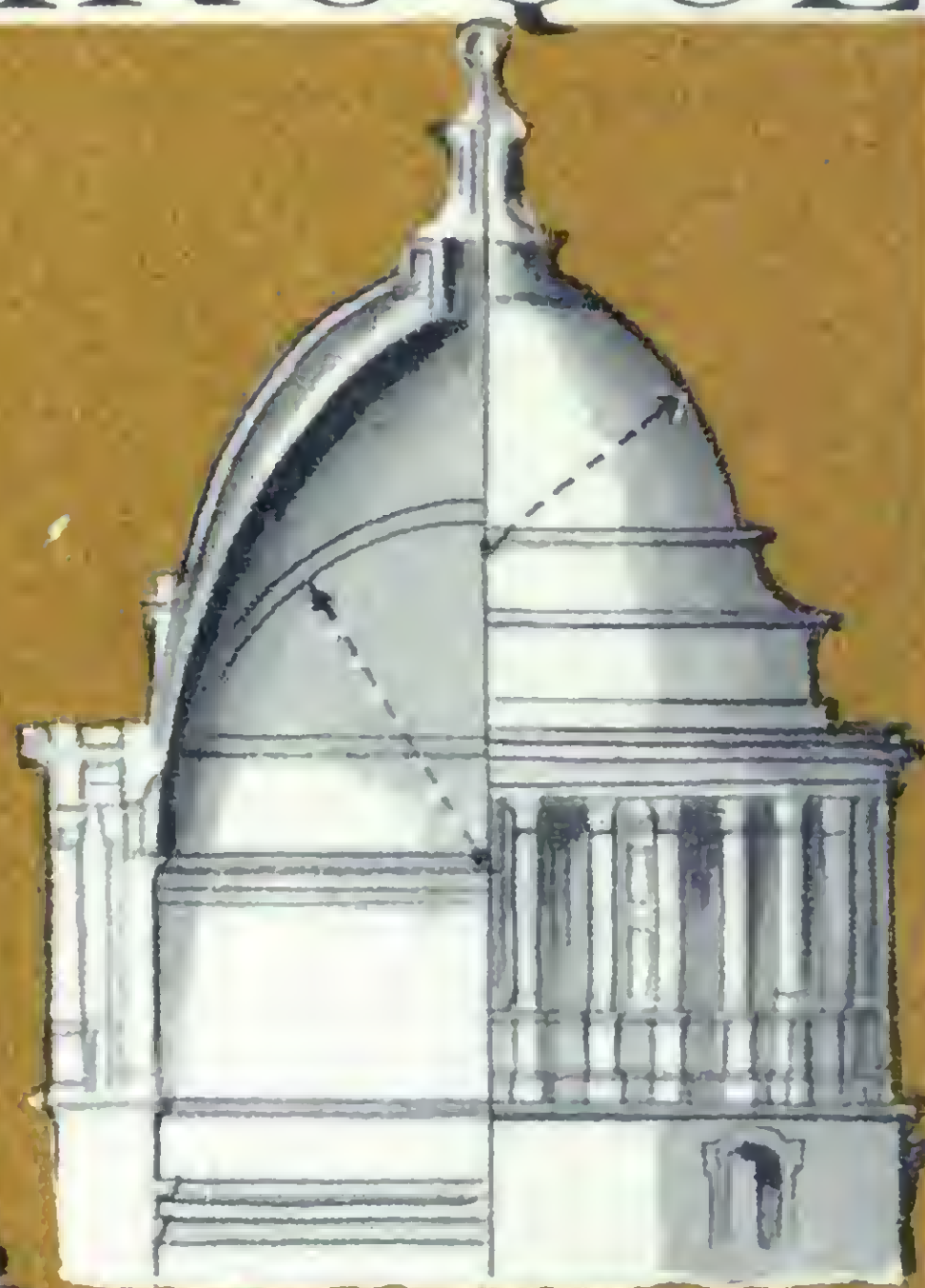


outer dome of timber  
covered with  
sheet lead,  
on a brick cone  
18" thick,  
also  
with an inner  
brick dome  
18" thick

355' 6"

C chains

Study  
for  
dome



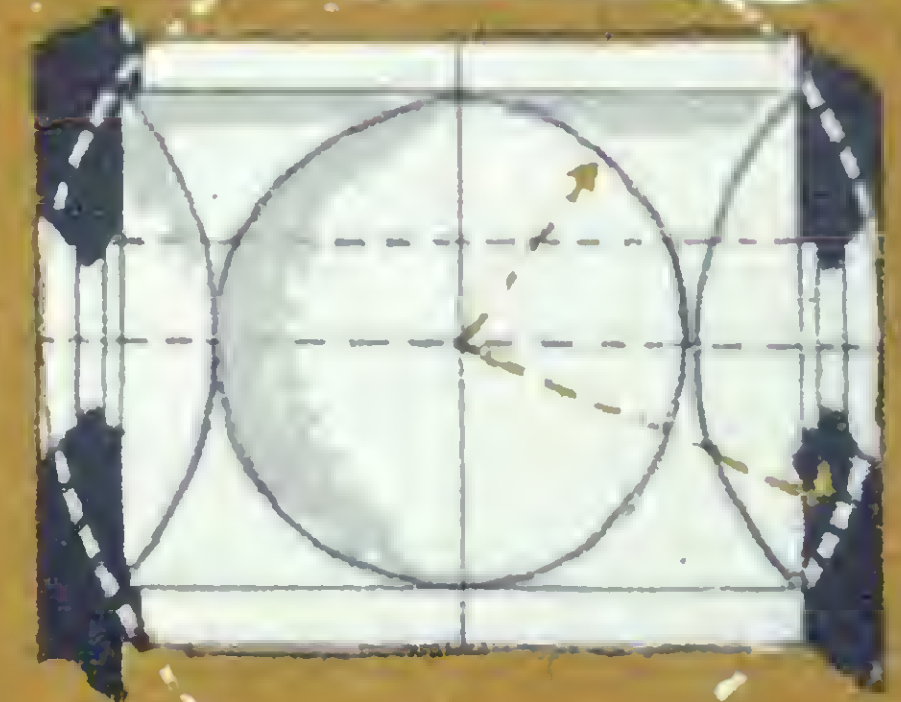
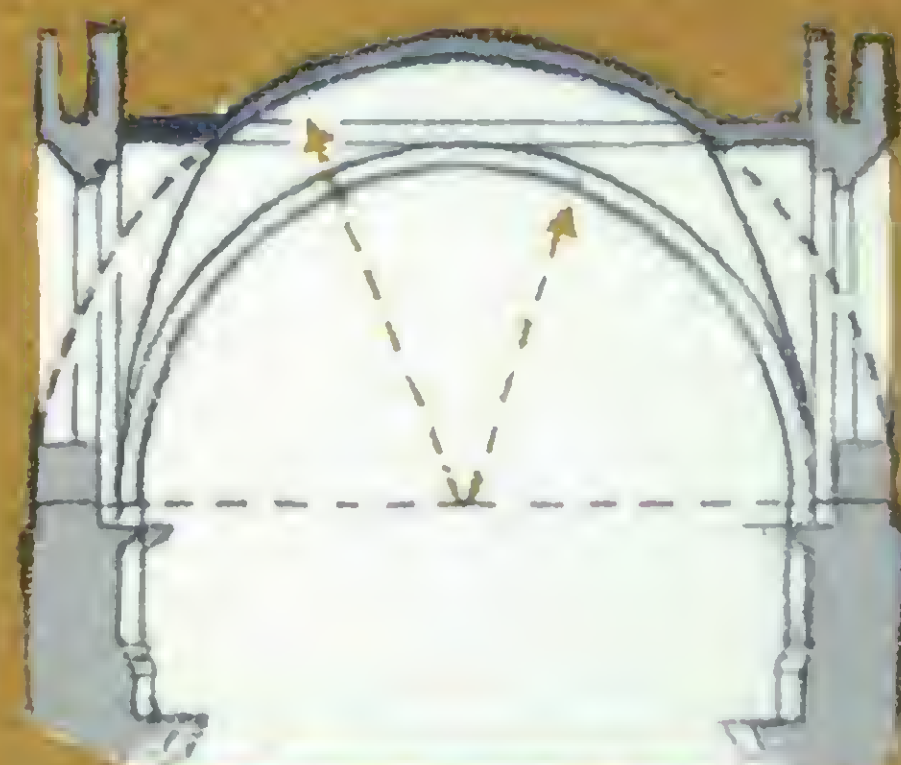
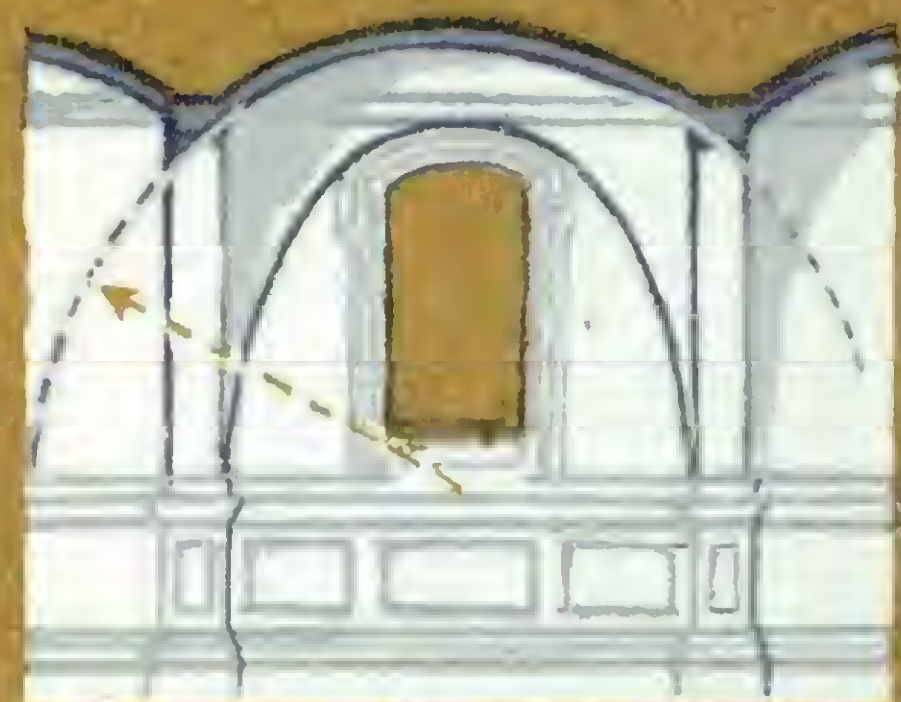
The  
mathematician  
Robert Hooke  
wrote that  
Wren used the  
'catenary line'

St Peter's, Rome:  
dome *Bramante*  
(1444-1514)  
(from Serlio)



St Paul's Cathedral, London,  
c. 1675-1711  
*Sir Christopher Wren*  
(1631-1723)

Vaulting of brick,  
walls of ashlar stone  
with rubble filling,  
façades of Portland stone



Section  
of nave



# RENAISSANCE - BAROQUE

*Sir Christopher Wren (1632-1723).*

Early scientific pursuits: optics, hyperbolic lenses & a treatise on cycloids.

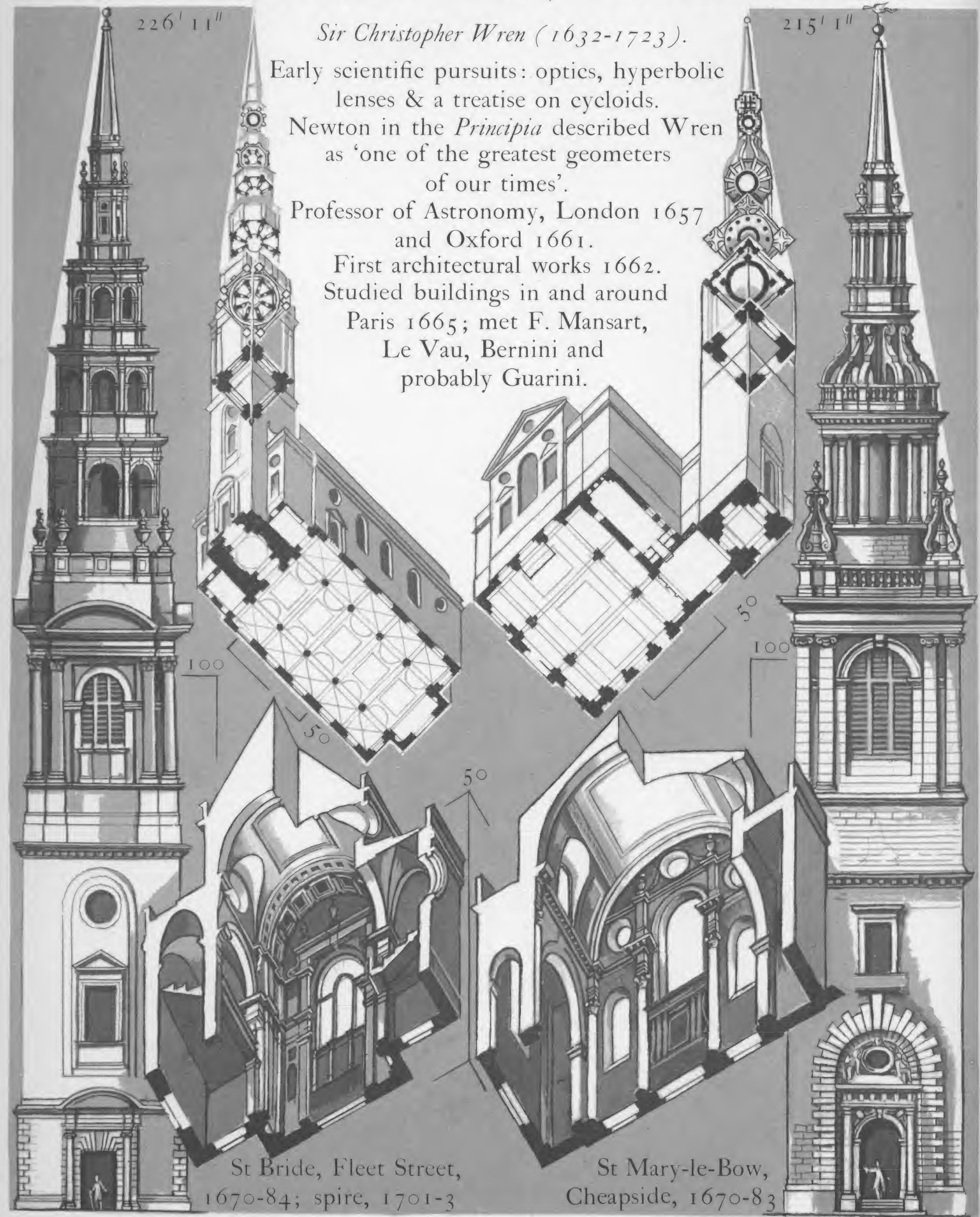
Newton in the *Principia* described Wren as 'one of the greatest geometers of our times'.

Professor of Astronomy, London 1657 and Oxford 1661.

First architectural works 1662.

Studied buildings in and around

Paris 1665; met F. Mansart, Le Vau, Bernini and probably Guarini.



St Bride, Fleet Street,  
1670-84; spire, 1701-3

St Mary-le-Bow,  
Cheapside, 1670-83



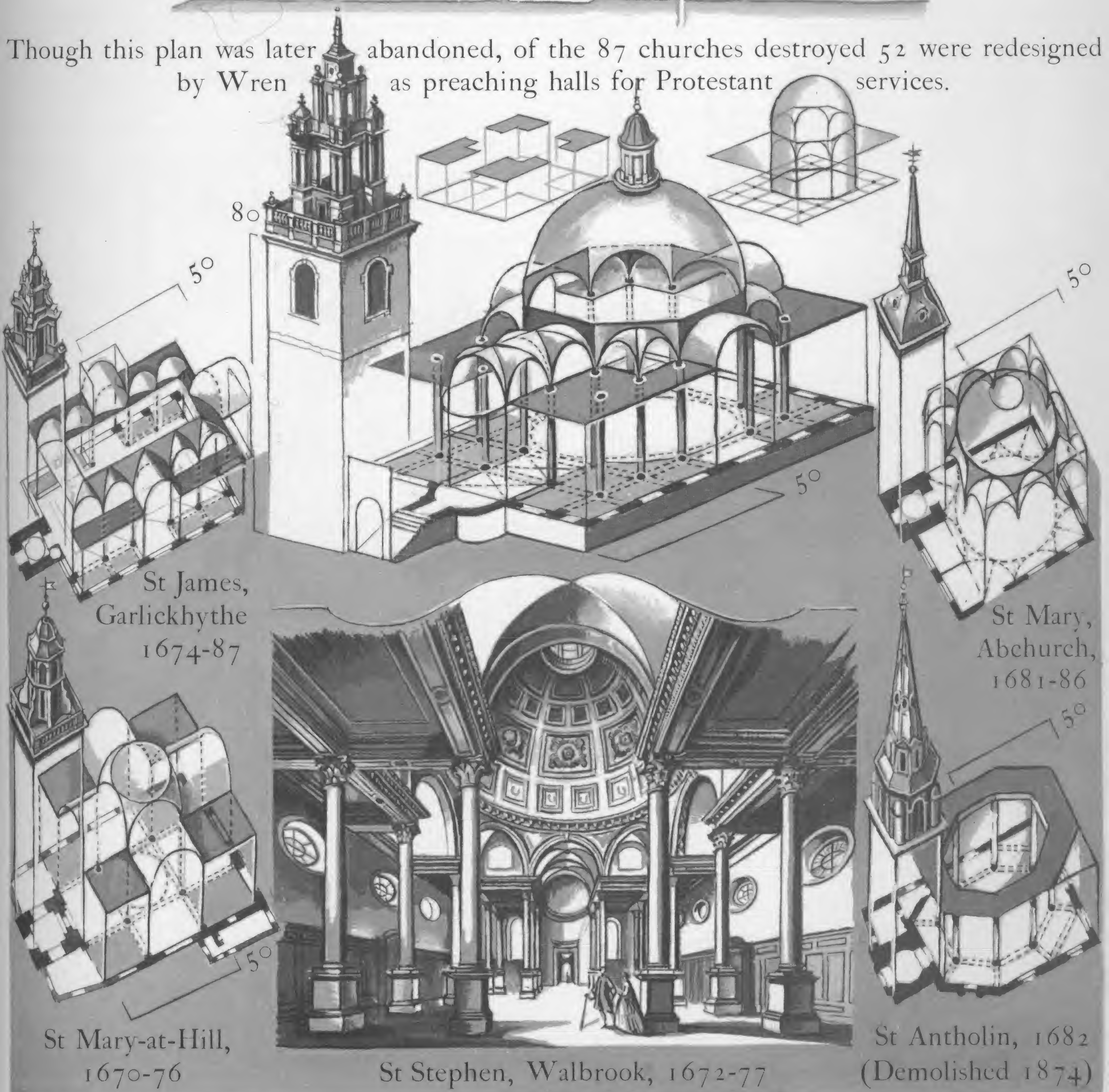
# ENGLAND, WREN'S CITY CHURCHES

The fire of London lasted from 2-5 September 1666. On 11 September



Wren submitted a plan for rebuilding the City of London.

Though this plan was later abandoned, of the 87 churches destroyed 52 were redesigned by Wren as preaching halls for Protestant services.



St James,  
Garlickhythe  
1674-87

St Mary-at-Hill,  
1670-76

St Stephen, Walbrook, 1672-77

St Mary,  
Abchurch,  
1681-86

St Antholin, 1682  
(Demolished 1874)

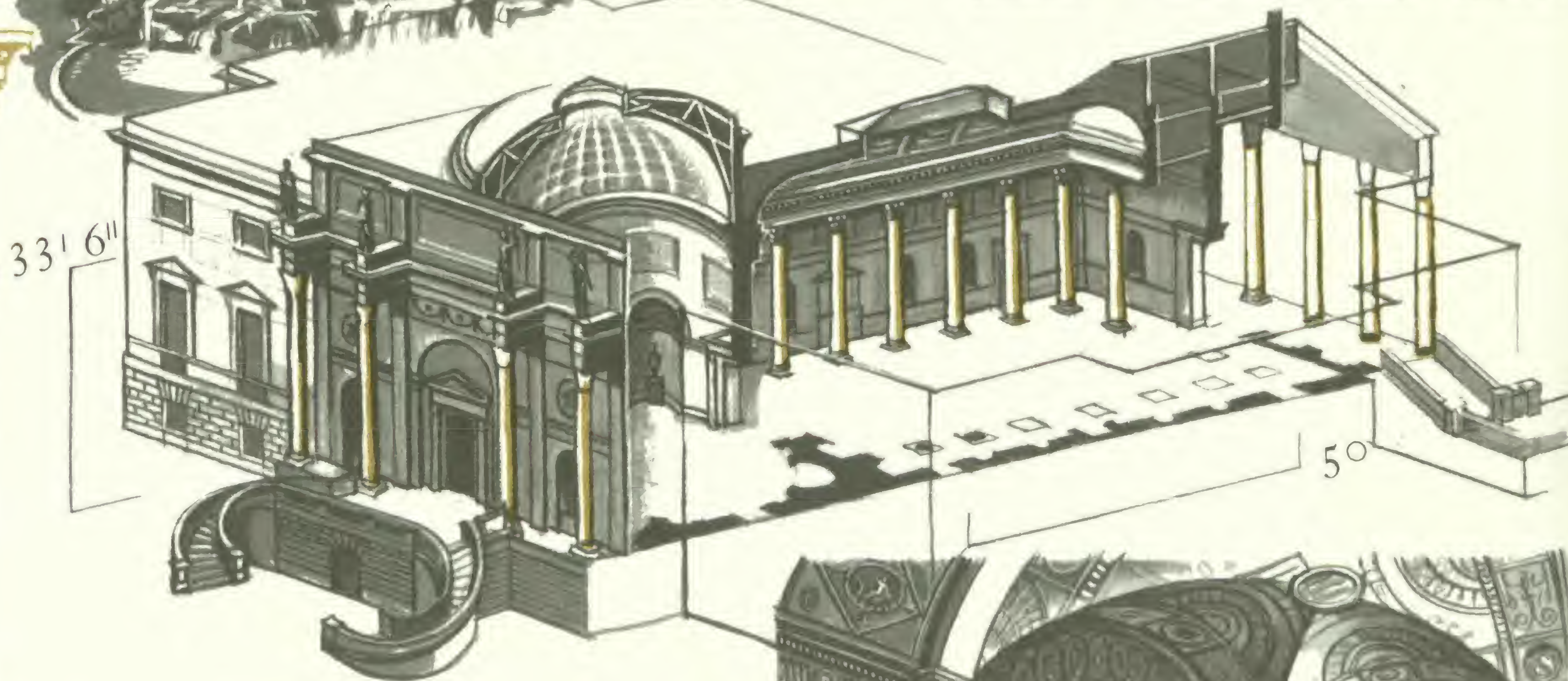
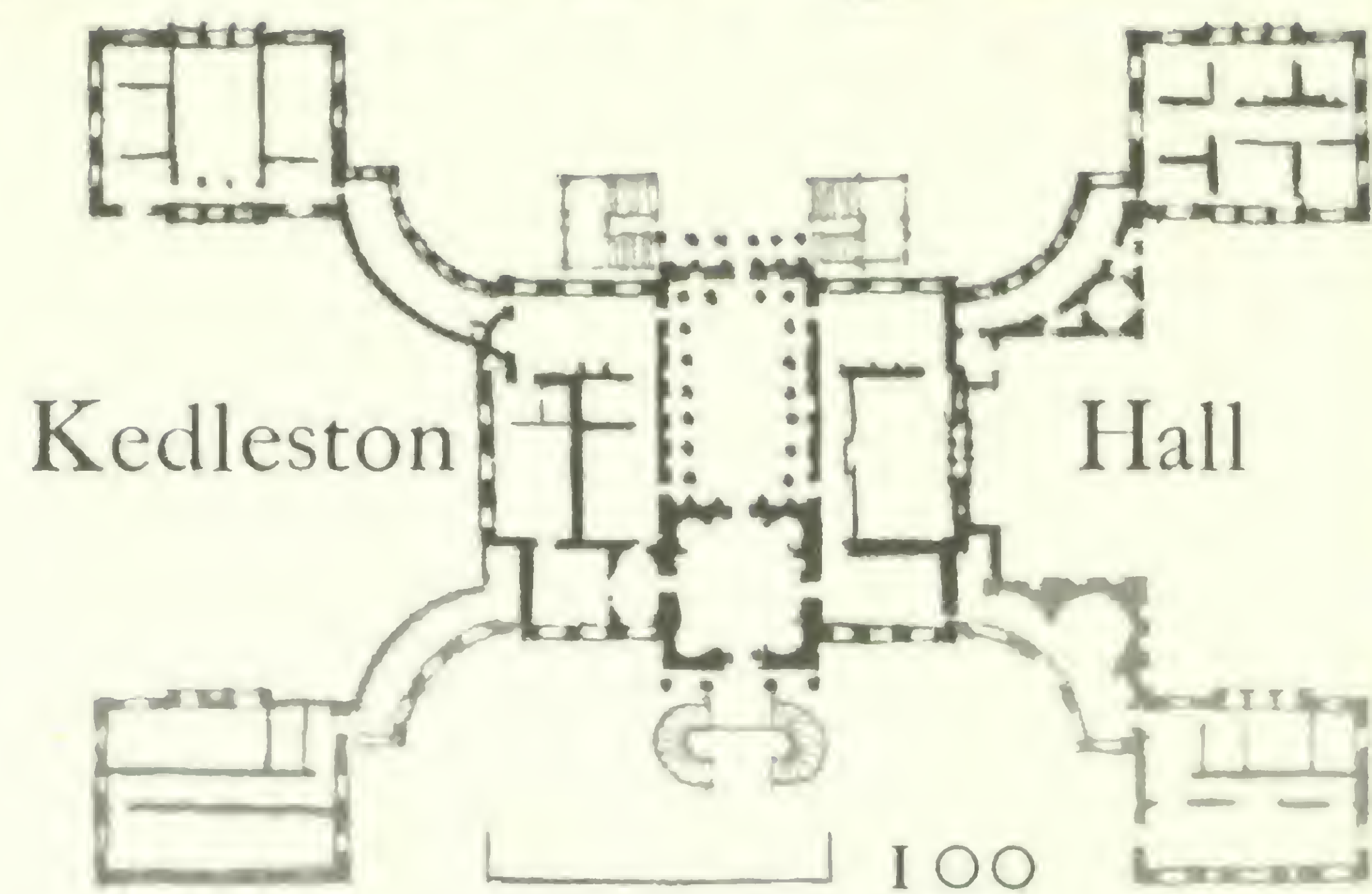


# RENAISSANCE - BAROQUE

Gate column: Syon House, Middlesex,  
1762-63 Robert Adam



Fontana  
Trevi,  
Rome,  
1732-1762  
*Salvi*



Kedleston Hall, Derbyshire, 1756-70  
designed by *James Paine* (1725-89);  
south front & interior by  
*Robert Adam* (1728-92).  
Studied in Italy 1754-58



26, Grosvenor Square, London,  
1773-74 *Adam* (demolished 1862)



Pitzhanger Place, Middlesex,  
1800-1803



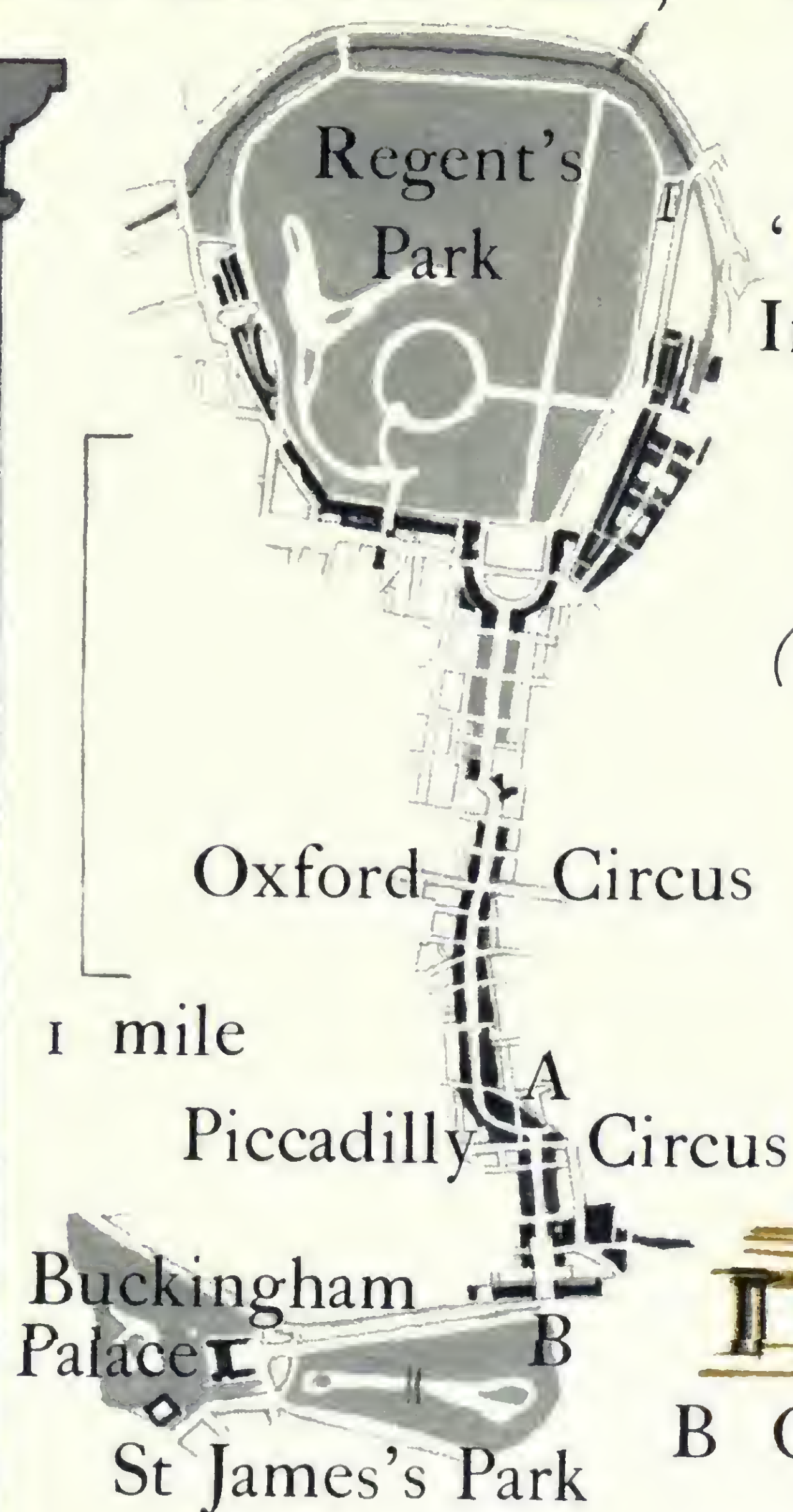
Bank Stock Office, Bank of England,  
1792-93 (demolished 1927)

*Sir John Soane* (1753-1837) Visited Italy 1778-1780



# ENGLAND, STONE, BRICK & IRON

section of cast-iron column Watt & Boulton  
Mill, 1801:



London's  
'Metropolitan  
Improvements'  
1812-1835

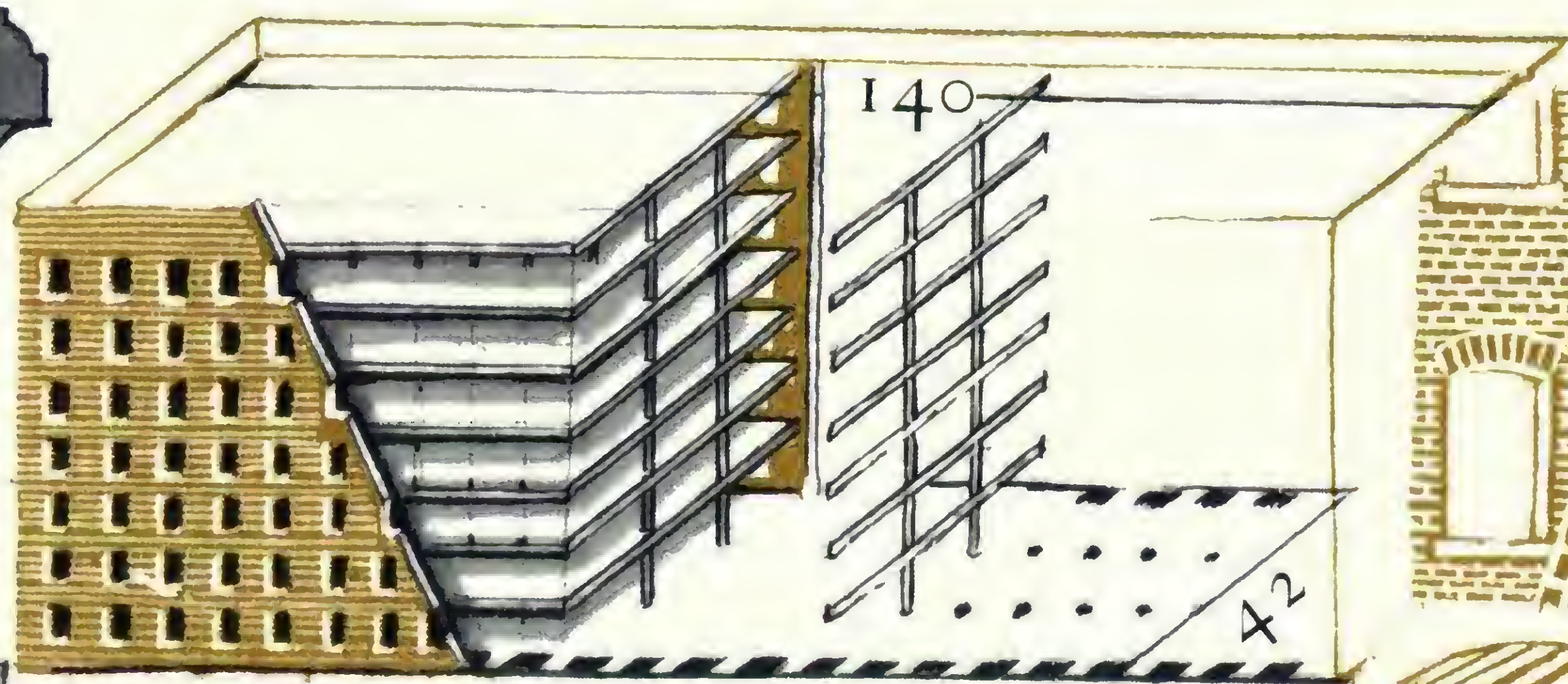
*John Nash*  
(1752-1835)



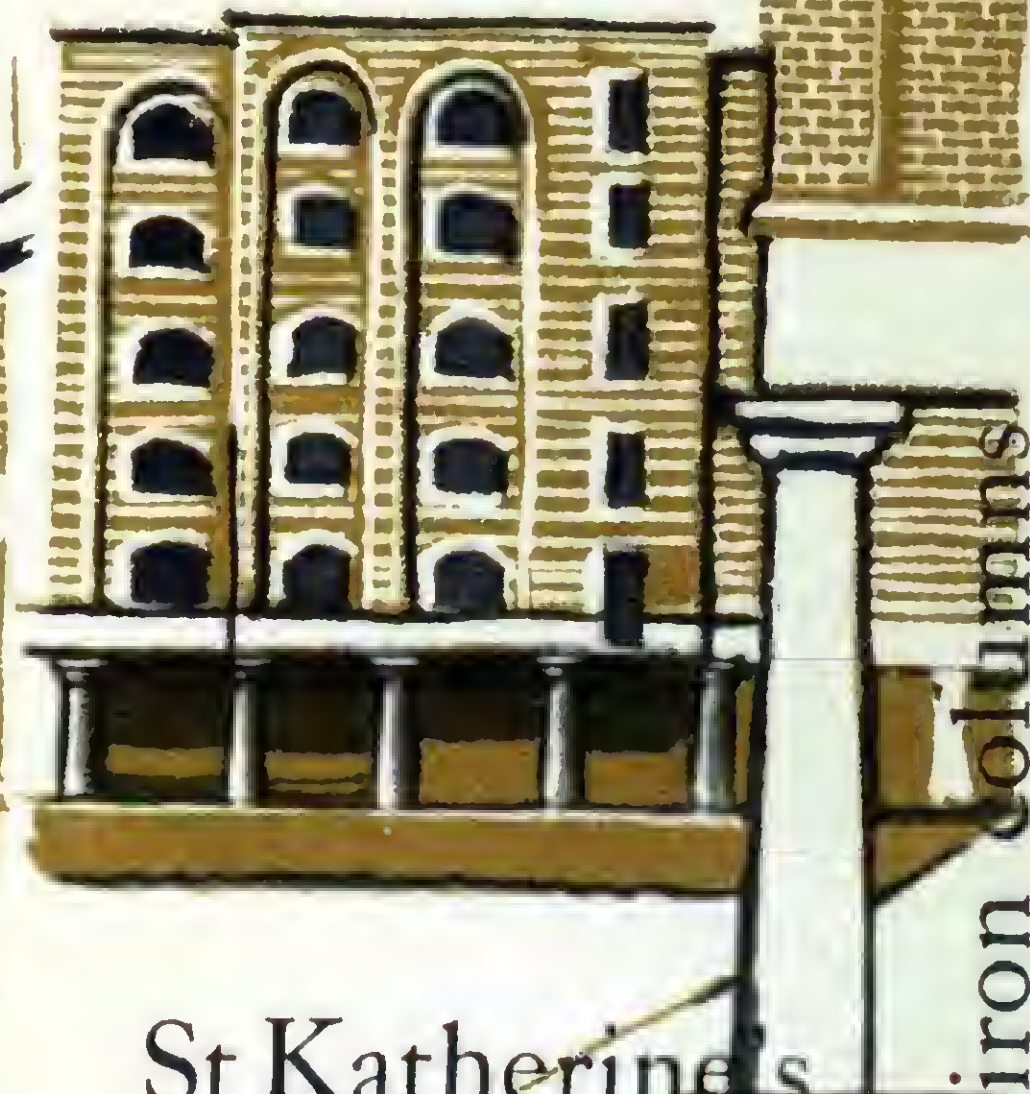
A The Quadrant, Regent Street 1818  
Cast-iron columns



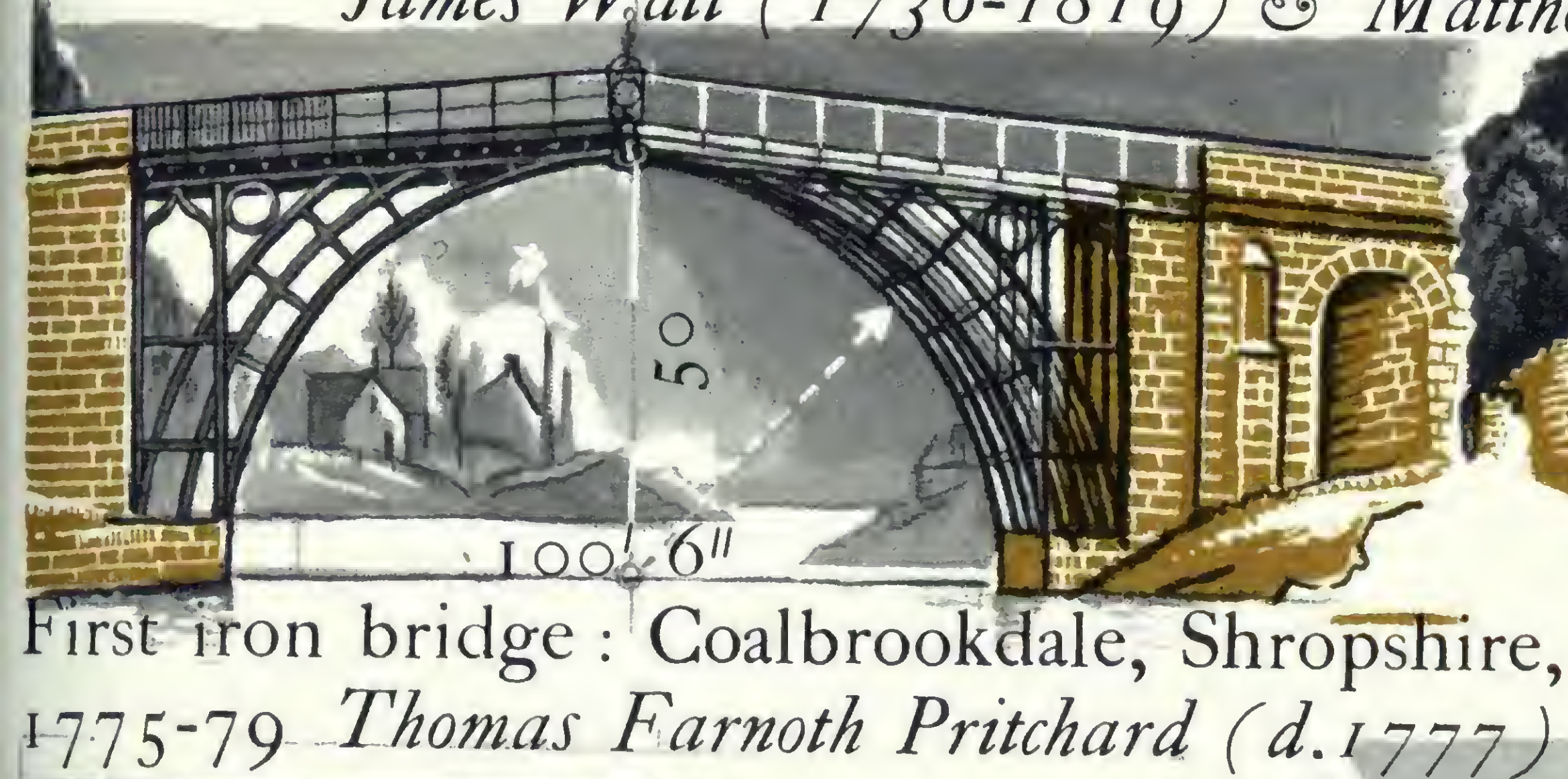
B Carlton House Terrace, 1827 Cast-iron Doric columns



Cotton mill, Manchester, 1801. Cast-iron columns & beams  
*James Watt (1736-1819) & Matthew Boulton (1728-1809)*



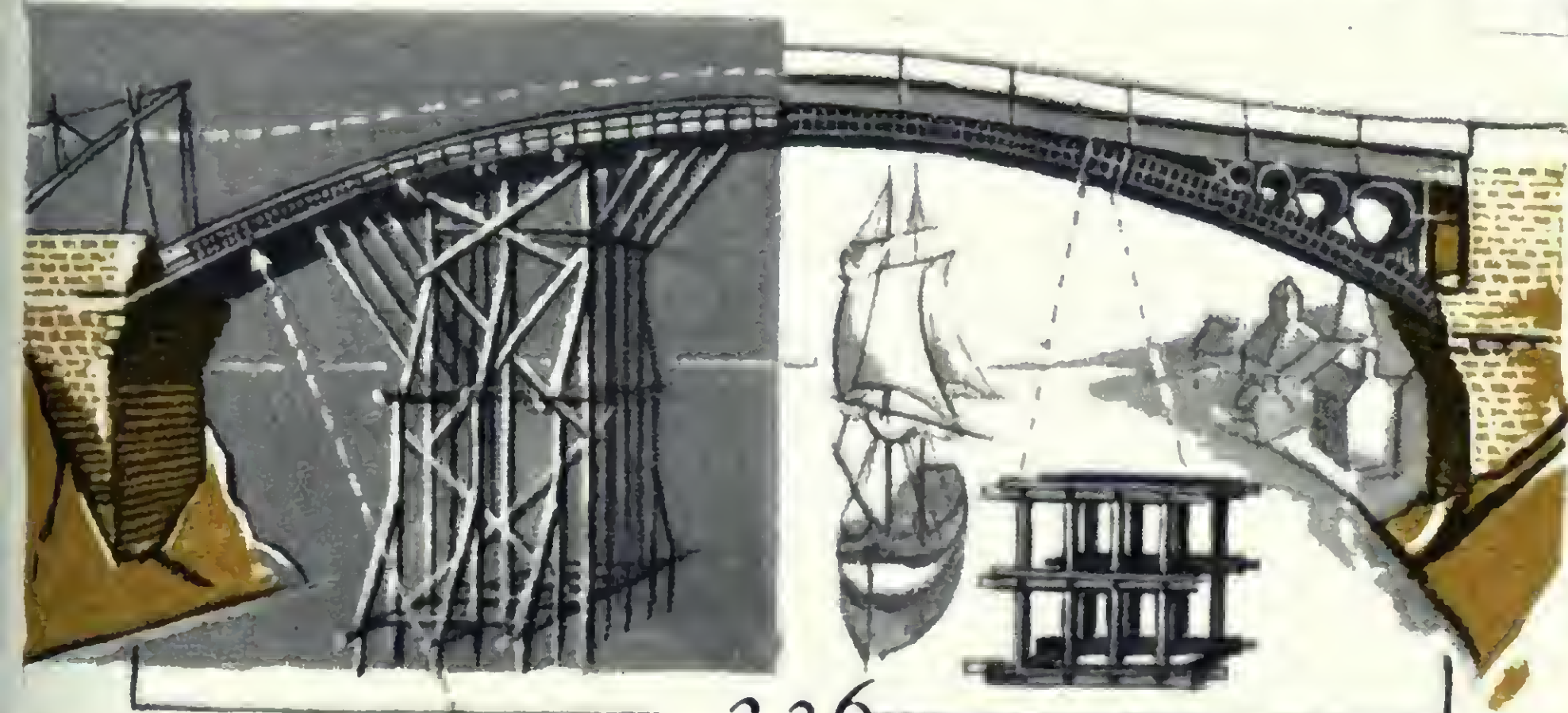
St Katherine's  
Dock, London,  
1828: *Telford*



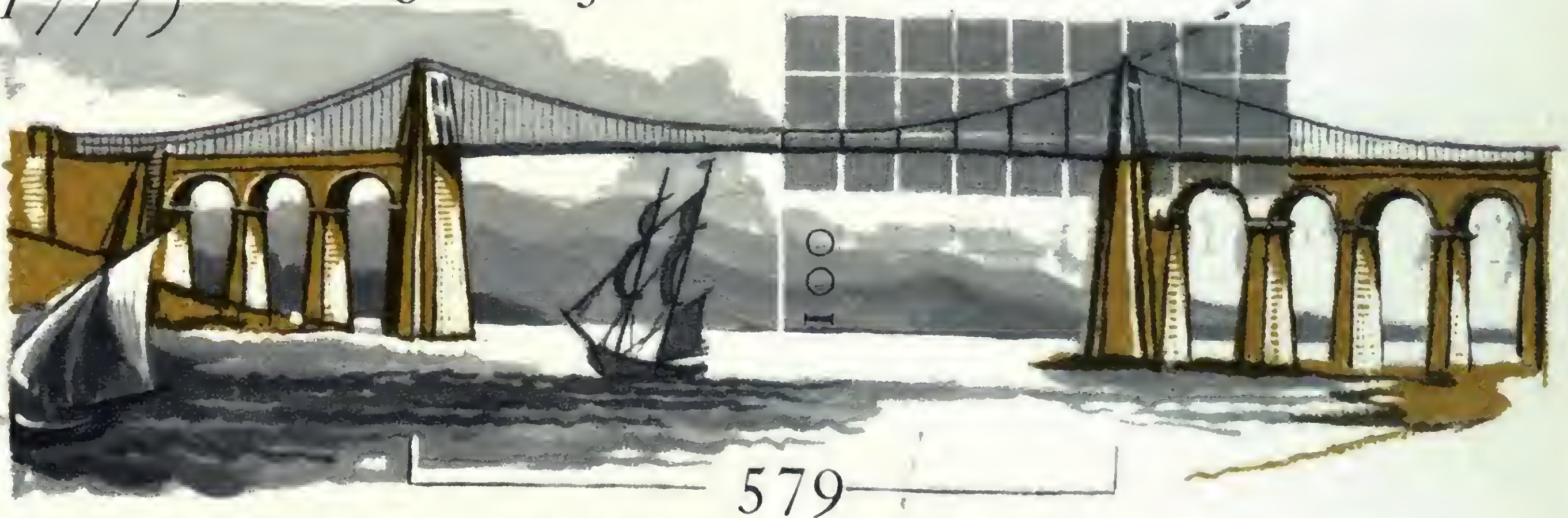
First iron bridge: Coalbrookdale, Shropshire,  
1775-79 *Thomas Farnoth Pritchard (d.1777)*



Cast-iron rib-and-truss Bridge, Craigellachie,  
1815 *Telford*



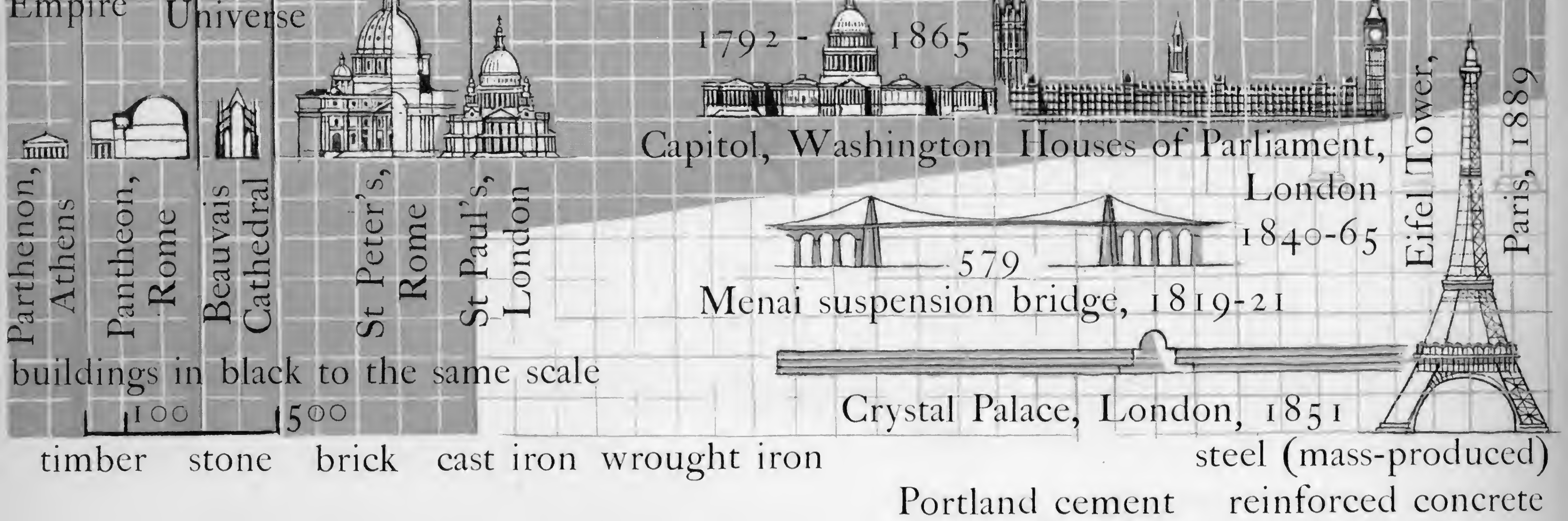
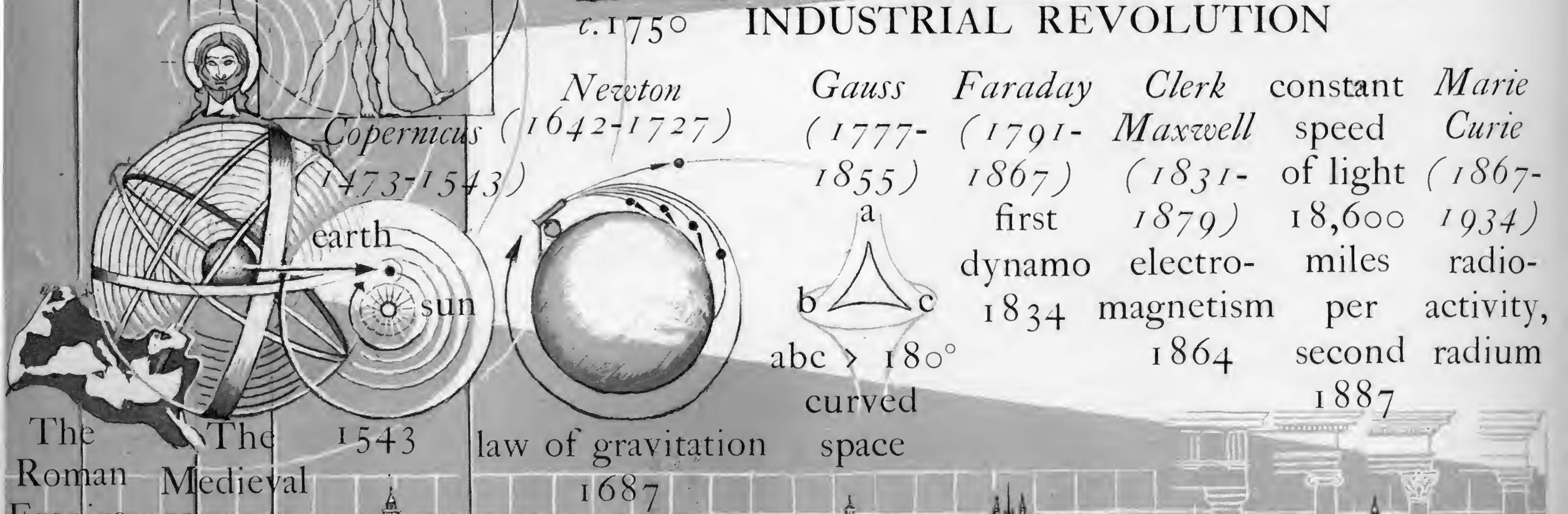
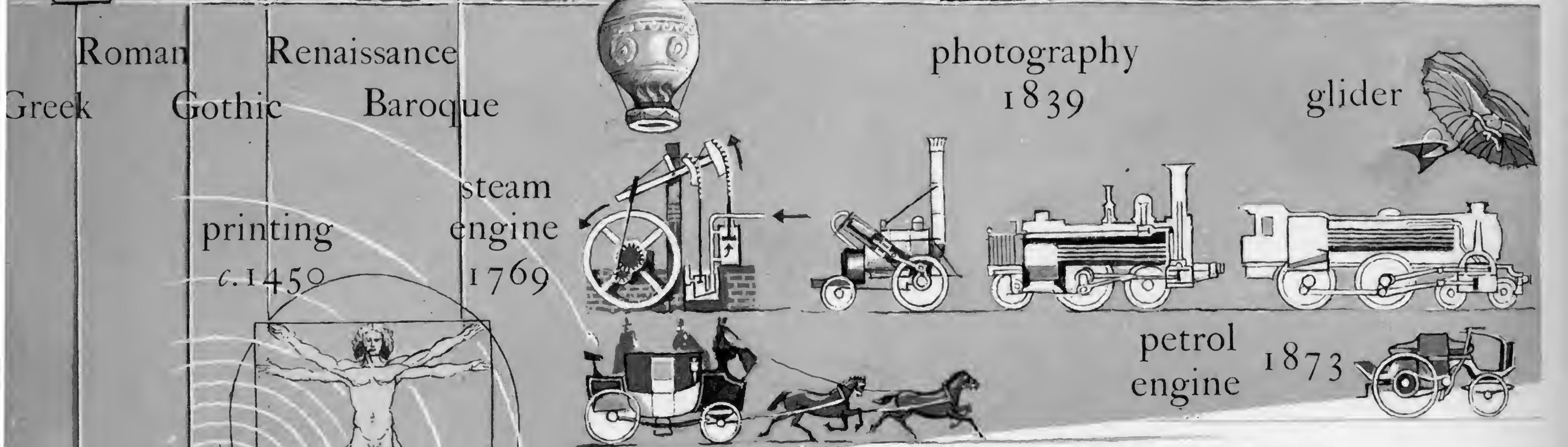
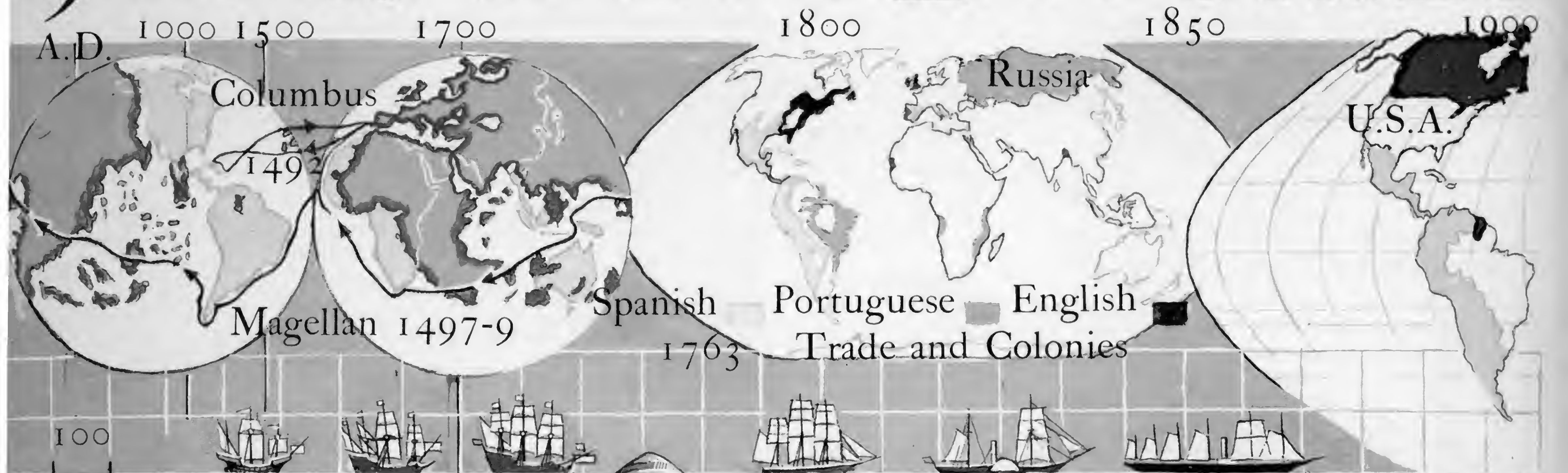
Cast-iron Bridge, Sunderland, 1793-96



Suspension Bridge, Menai Straits, 1819-26  
*William Telford (1751-1834)*

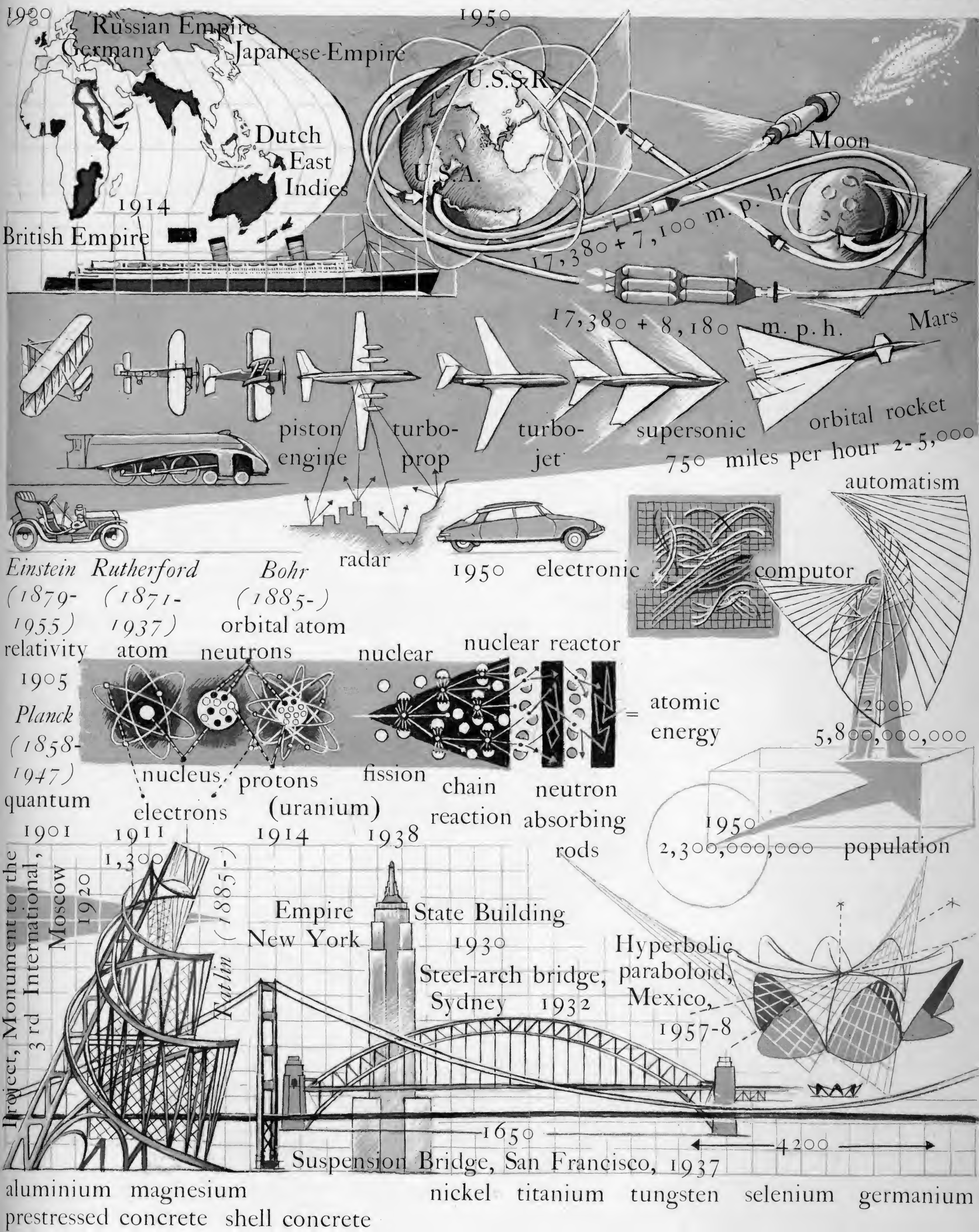


# 9TH & 20TH CENTURIES





# INTRODUCTION



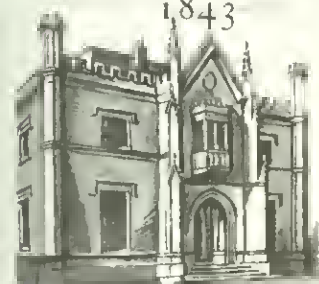


# 19 TH & 20 TH CENTURIES



22 churches and chapels built by  
*Augustus Welby Northmore Pugin*  
(1812-52)

from frontispiece to  
*An Apology for the  
Revival of  
Christian Architecture*,  
1843

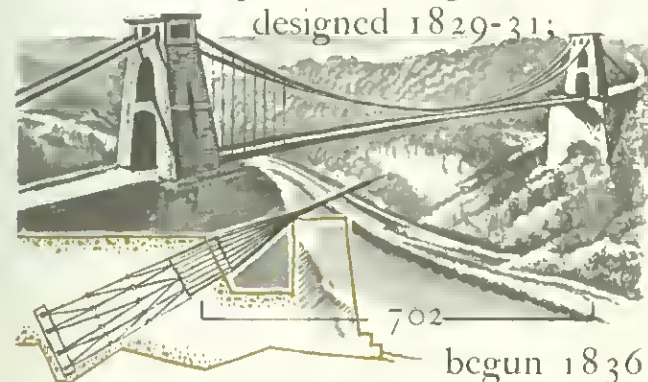


Regency Villas, Cheltenham,  
c.1825



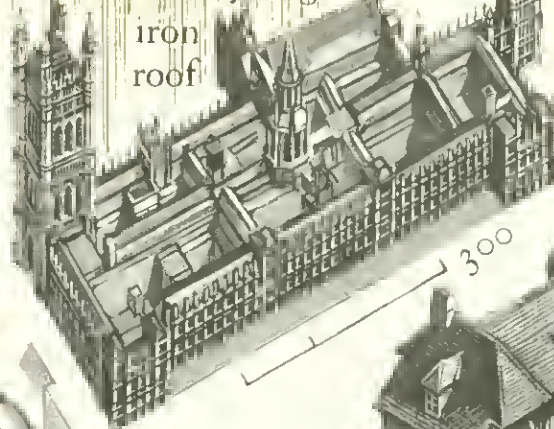
Classic

Clifton Suspension Bridge, Bristol,  
designed 1829-31;



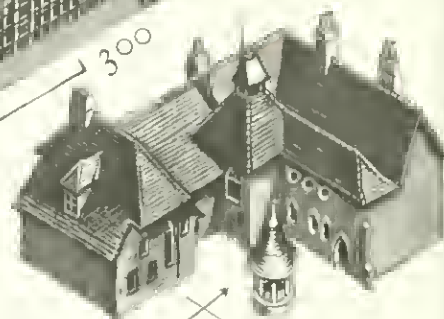
begun 1836  
*Isambard Kingdom Brunel* (1806-59)

The Houses of Parliament,  
London, 1840-65 *Sir Charles  
Barry* (1795-1866),  
assisted by *Pugin*



iron  
roof

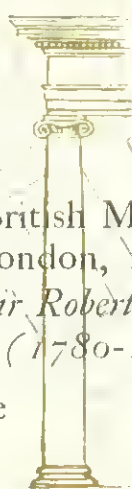
*John Ruskin*  
(1819-1900),  
*The Seven Lamps  
of Architecture*,  
1849  
*The Stones  
of Venice*,  
1851



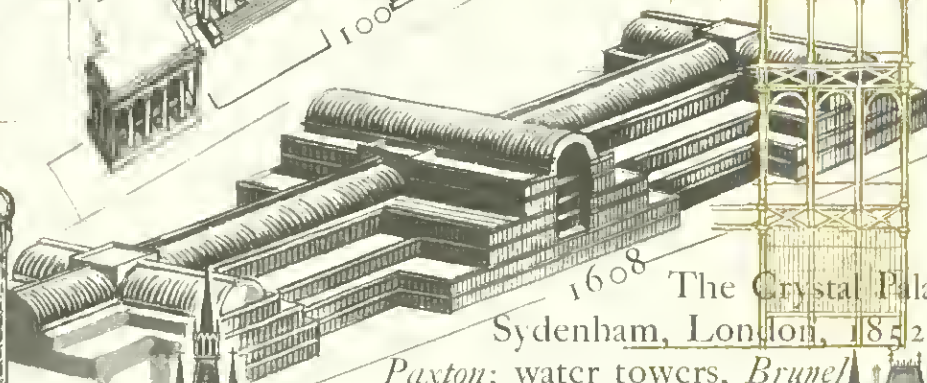
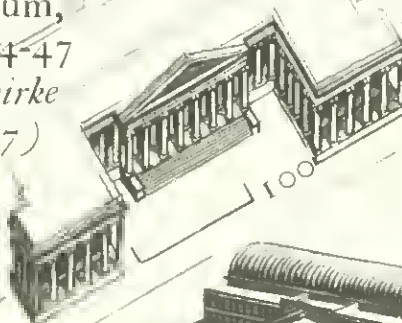
The Red House, Kent, 1859  
*Philip Webb* (1831-1915)  
for *William Morris*  
(1834-96)

British Museum,  
London, 1824-47  
*Sir Robert Smirke*  
(1780-1847)

Gothic

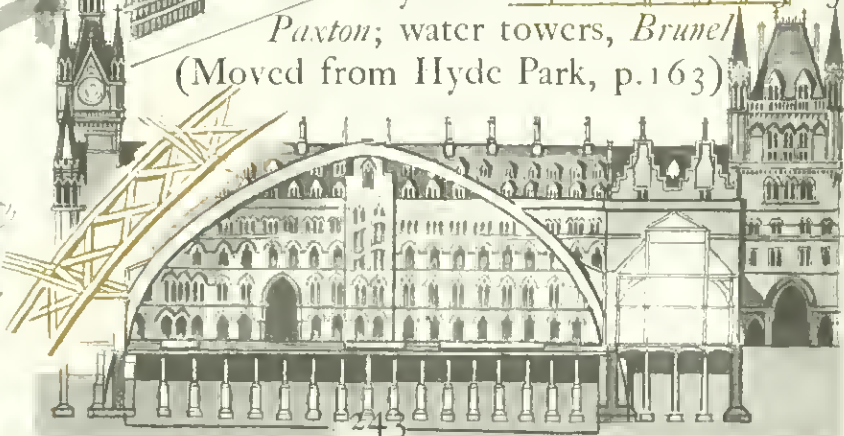


cast-iron  
dome  
*Sidney Smirke*  
(1799-1877)



The Crystal Palace,  
Sydenham, London, 1852-54  
*Paxton*; water towers, *Brunel*  
(Moved from Hyde Park, p.163)

St Pancras Station, London, 1865-73. Engineers,  
*W.H. Barlow* (1812-1902) & *M. Ordish* (1824-88)  
Hotel, 1865-75 *Sir George Gilbert Scott* (1810-77)

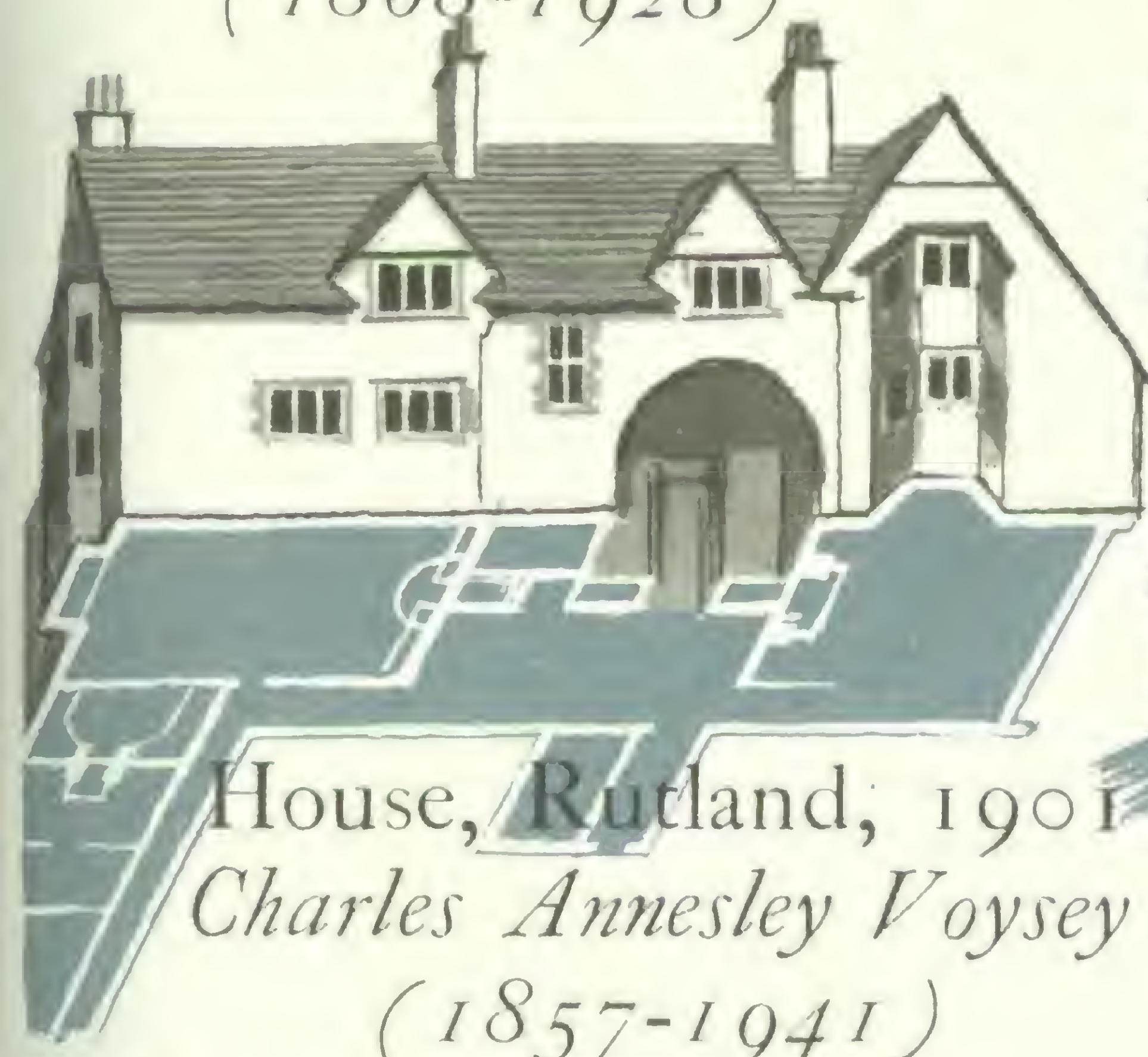




# ENGLAND



School of Art, Glasgow,  
1896 Art Nouveau  
*Charles Rennie Mackintosh*  
(1868-1928)

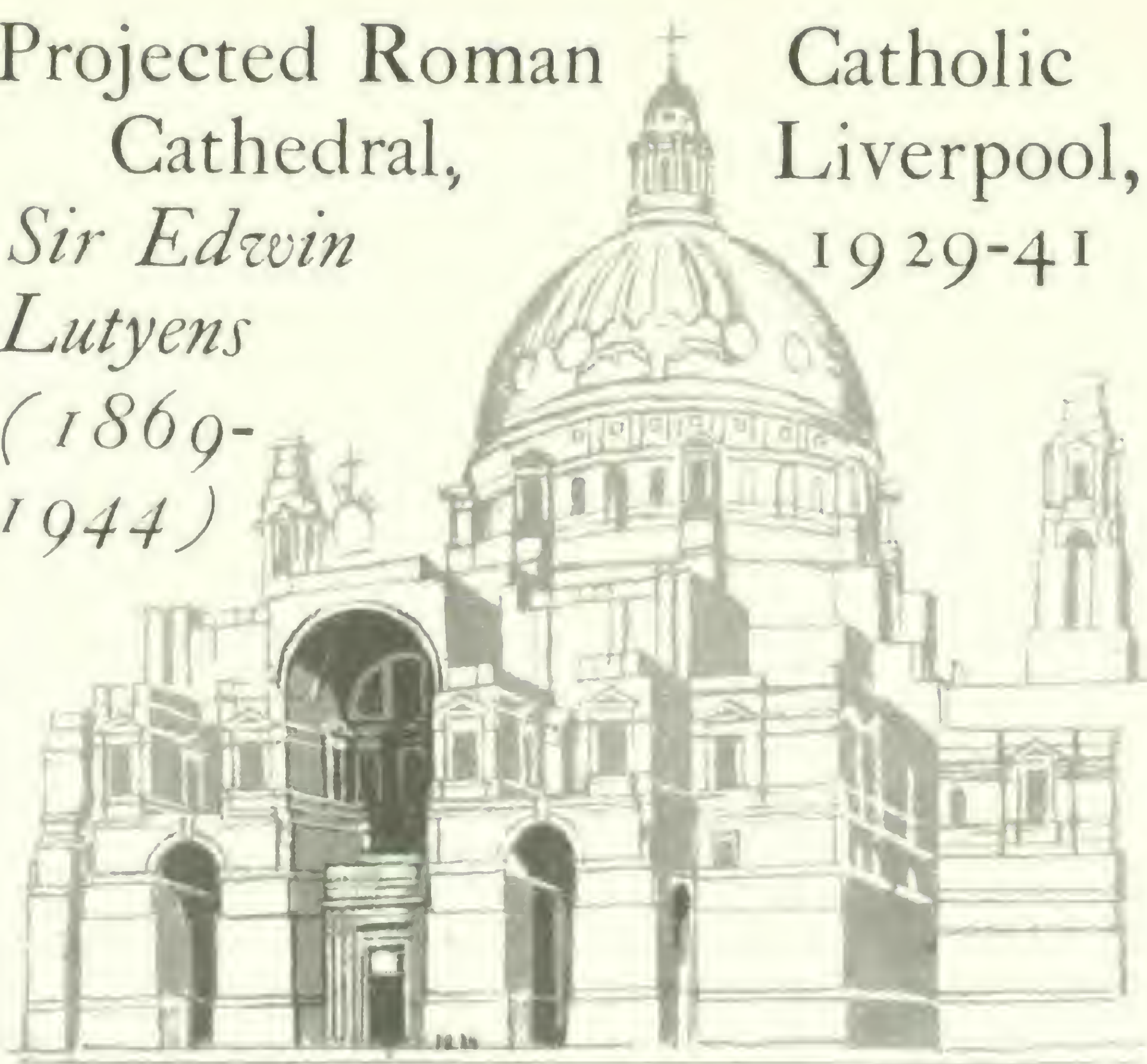


House, Rutland, 1901  
*Charles Annesley Voysey*  
(1857-1941)

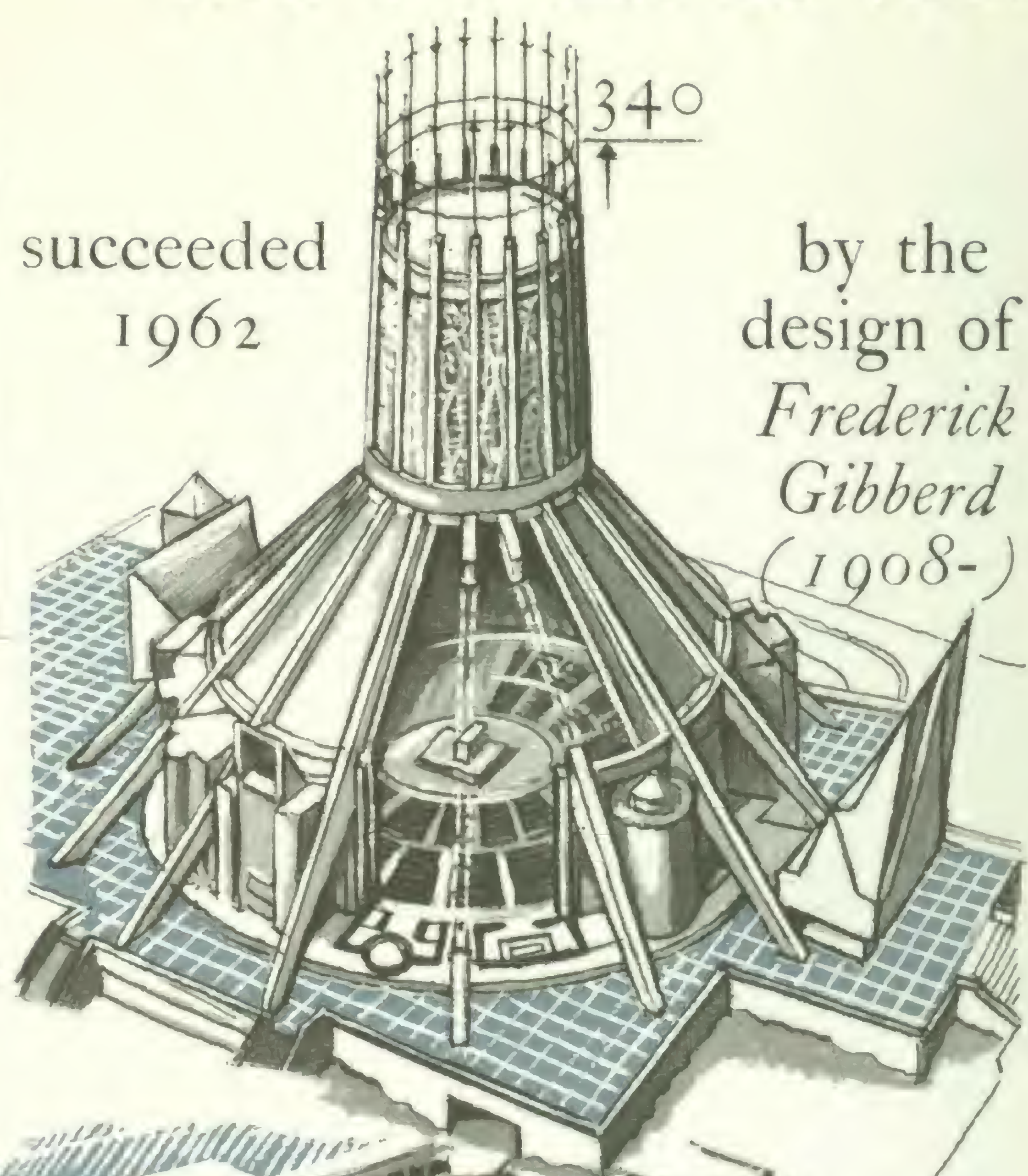


Heal & Son Store, London,  
1910-14 *Smith & Brewer*

Projected Roman  
Cathedral,  
*Sir Edwin*  
*Lutyens*  
(1869-  
1944)



Catholic  
Liverpool,  
1929-41 succeeded  
1962



by the  
design of  
*Frederick*  
*Gibberd*  
(1908-)

Village College, Impington,  
Cambridgeshire, 1936

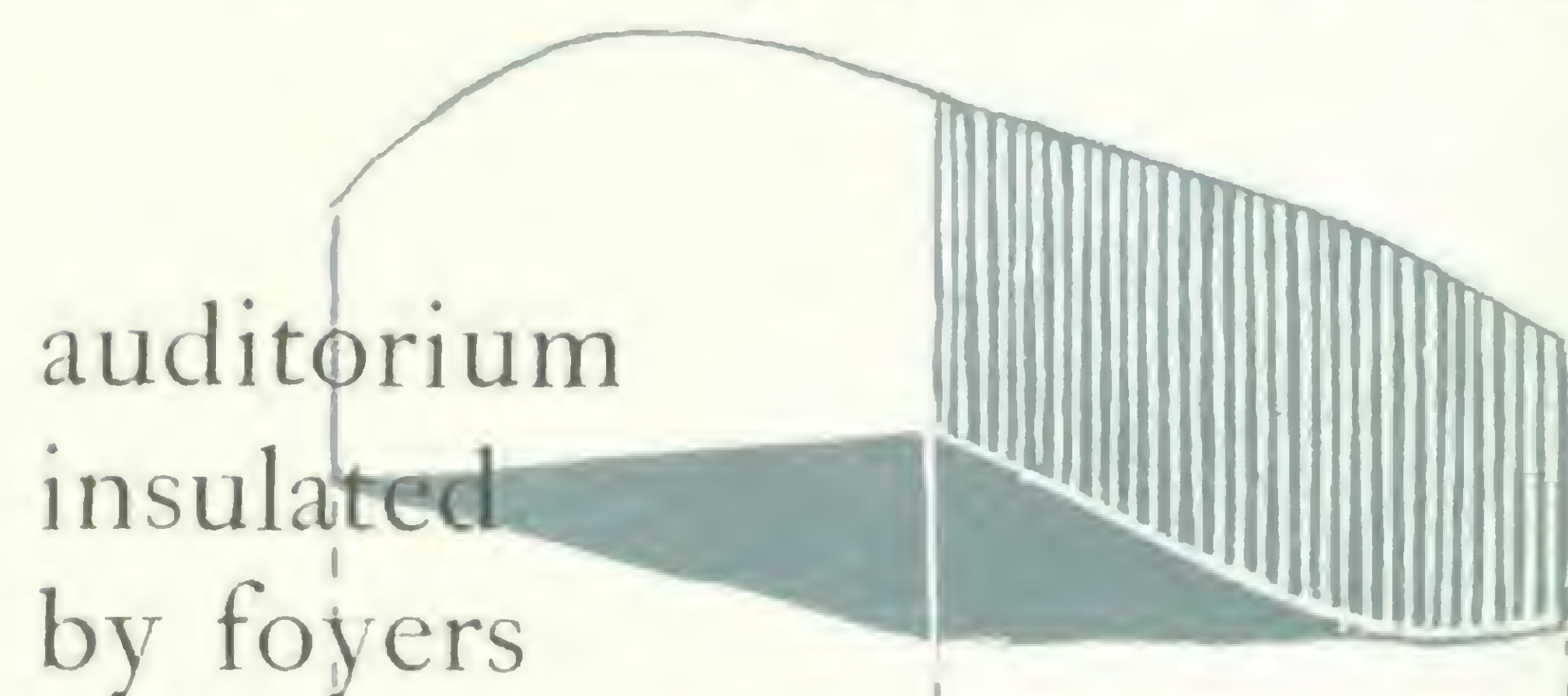
*Walter Gropius* (1883-)  
(pp. 174-5)  
& *Edwin*  
*Maxwell Fry*  
(1899-)



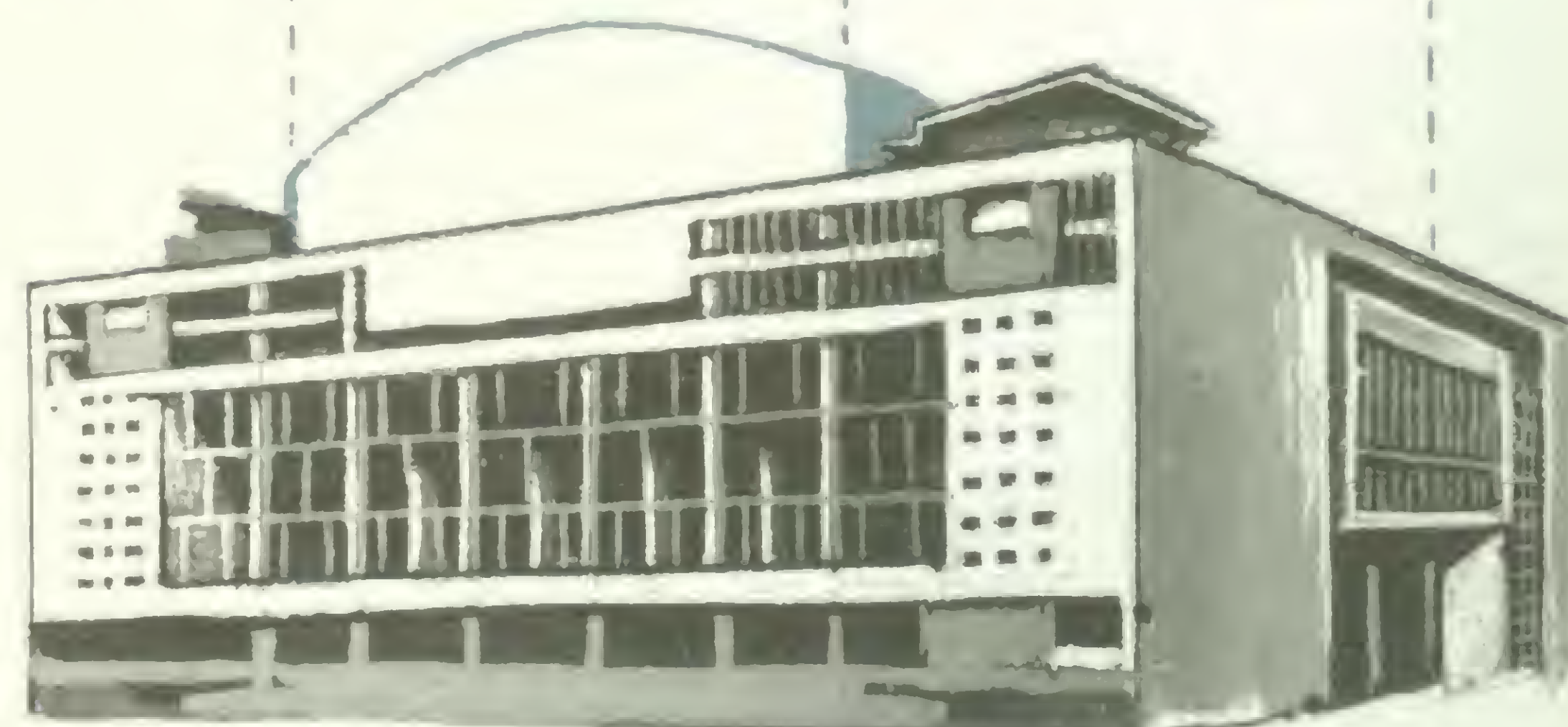
House,  
Sussex,  
1937  
*F. R. S. Yorke* (1906-62)  
& *Marcel Breuer* (1902-):  
born Hungary, U.S.A. 1937



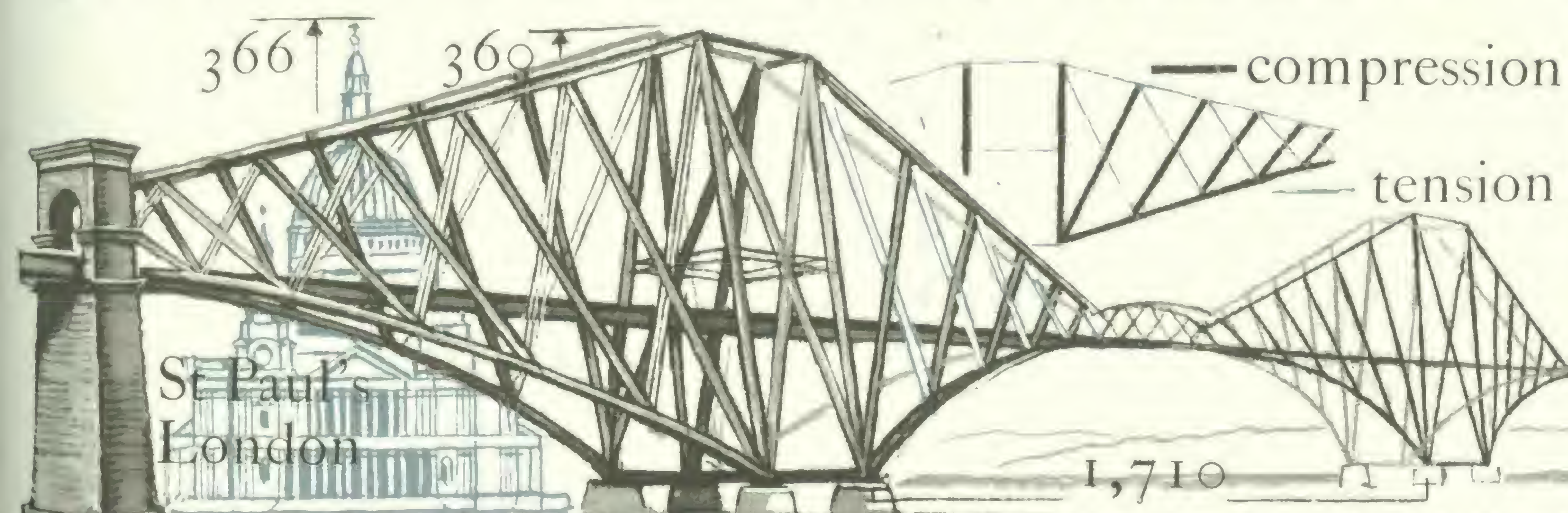
Peter Jones Store, London,  
1936-39 *William Crabtree*



auditorium  
insulated  
by foyers



Royal Festival Hall, London,  
1951 *Robert Hogg*  
*Matthew* (1906-)



St Paul's  
London

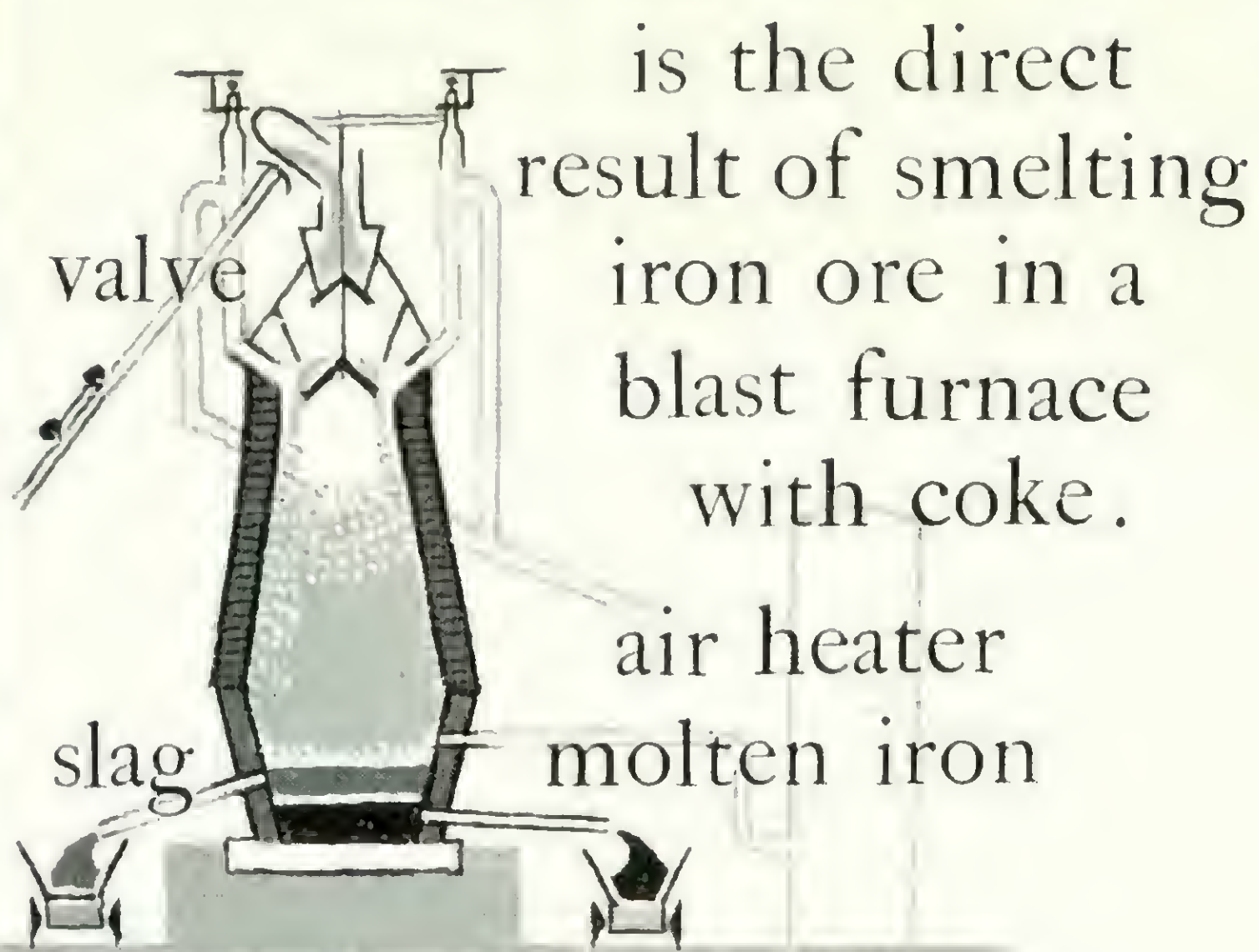
1,710

The Forth Bridge, 1882-1890 *Sir Benjamin Baker* & *Sir John Fowler*



# 19 TH & 20 TH CENTURIES

## CAST IRON



is the direct result of smelting iron ore in a blast furnace with coke.

The liquid ore solidifies on cooling & can be given the desired shape by being poured into moulds. The process was first carried out c.1710 by *Benjamin Darby (1677-1717)*. Cast iron is brittle & reacts to bending stress. Used primarily for vertical columns

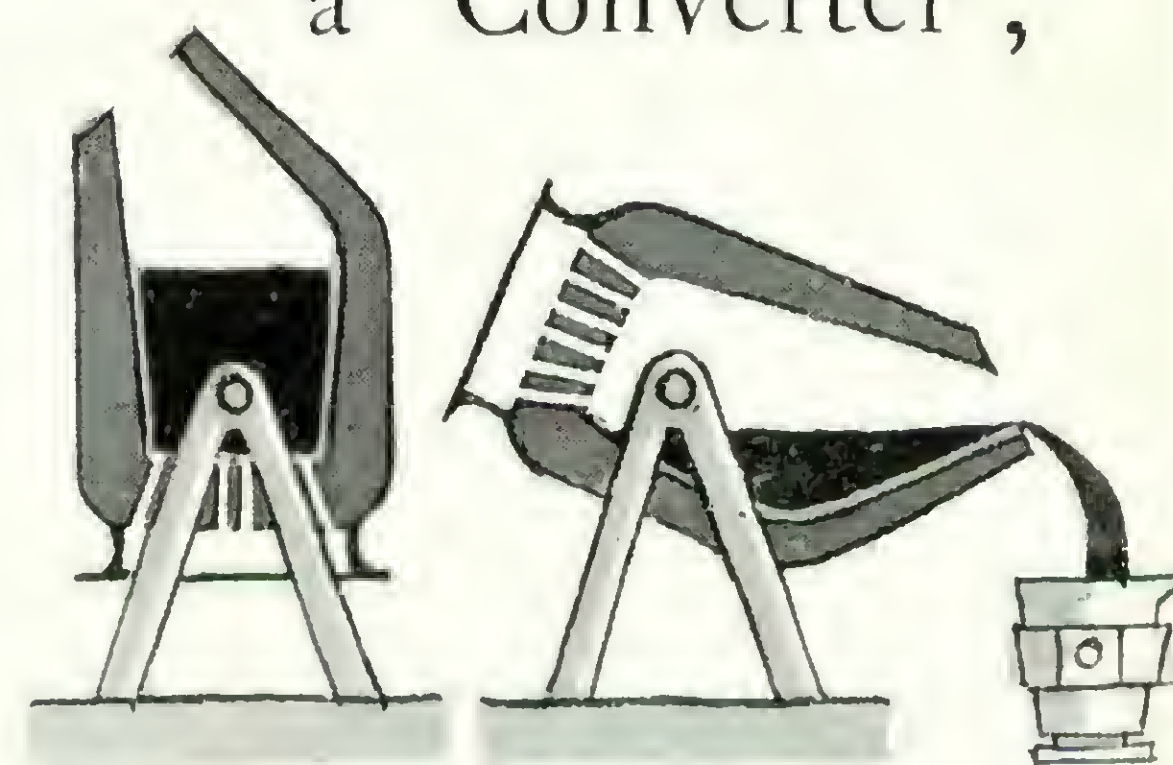
## WROUGHT IRON

is obtained by oxidizing white-hot cast iron. It is puddled (purified) from an excess of carbon & impurities in a 'reverberatory' furnace, introduced by *Henry Cort c.1760s*.

Ductile and malleable, wrought-iron can be pulled out into wire or rolled into beams

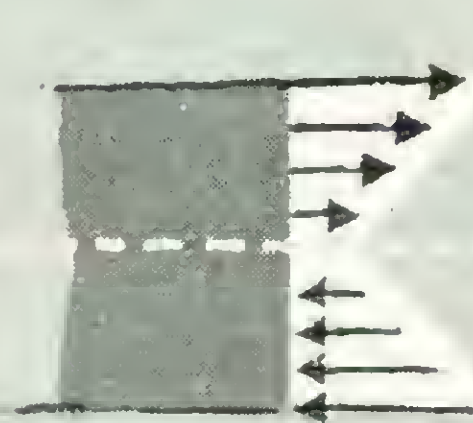
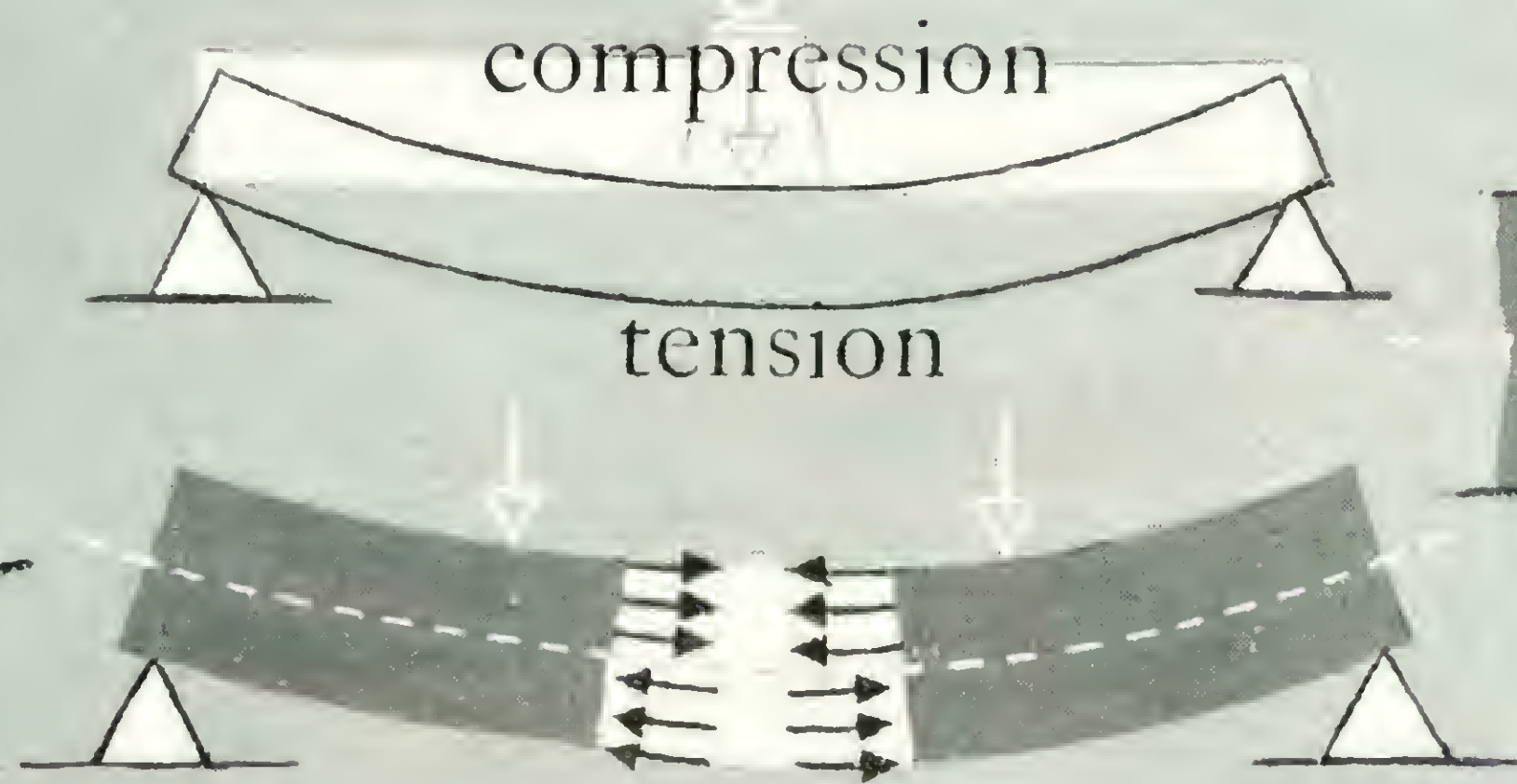
## STEEL

is made from cast-iron, the carbon being burnt out by a blast of air through the molten metal in a 'Converter',

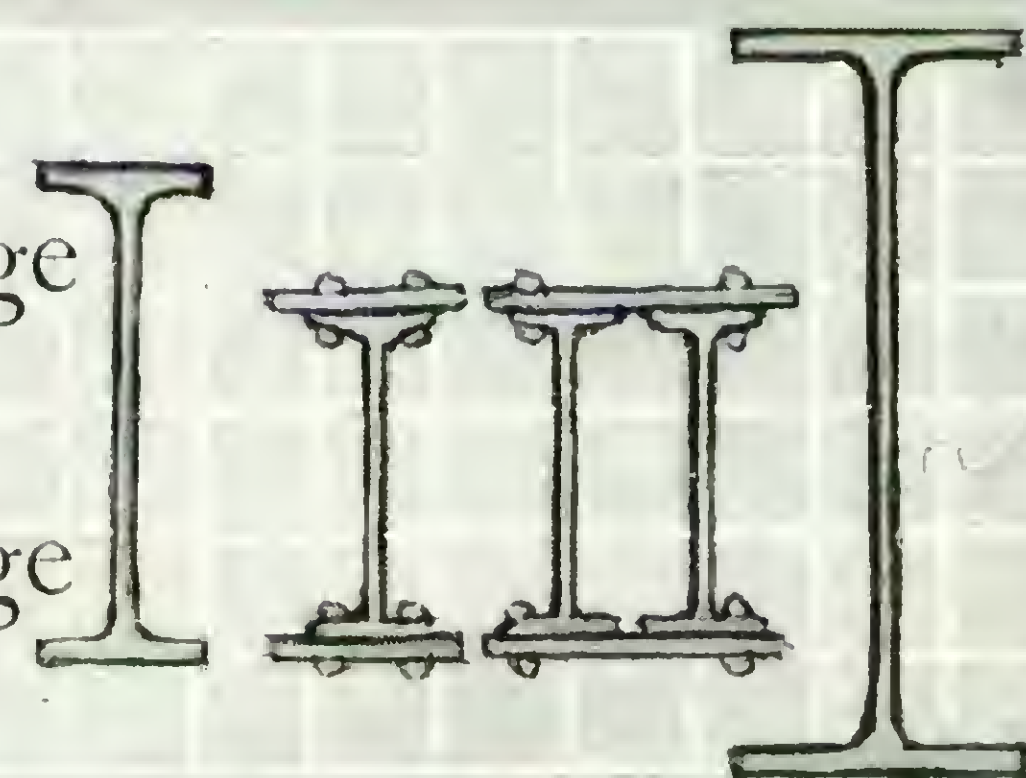


invented by *Sir Henry Bessemer* in 1856. Steel has equal strength in compression and tension

## THE BEAM

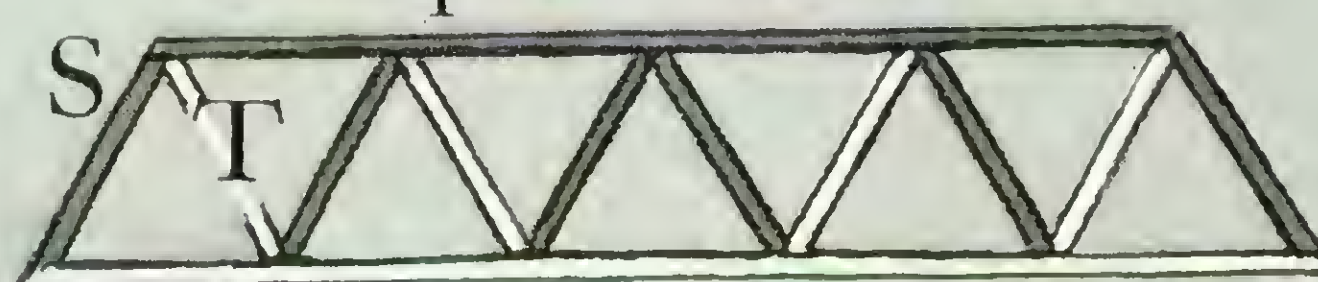


flange  
web  
flange



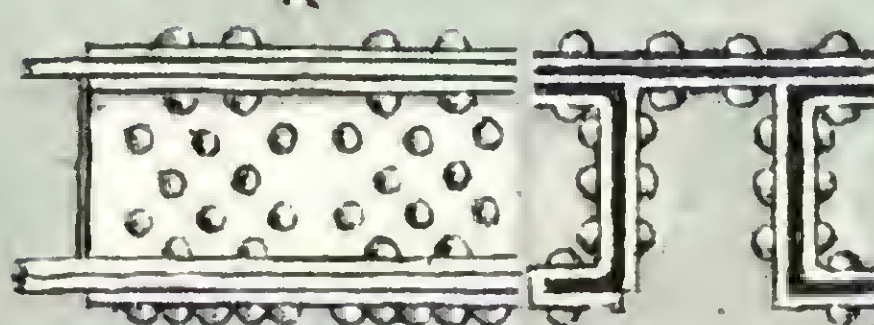
## & TRUSS

compression boom



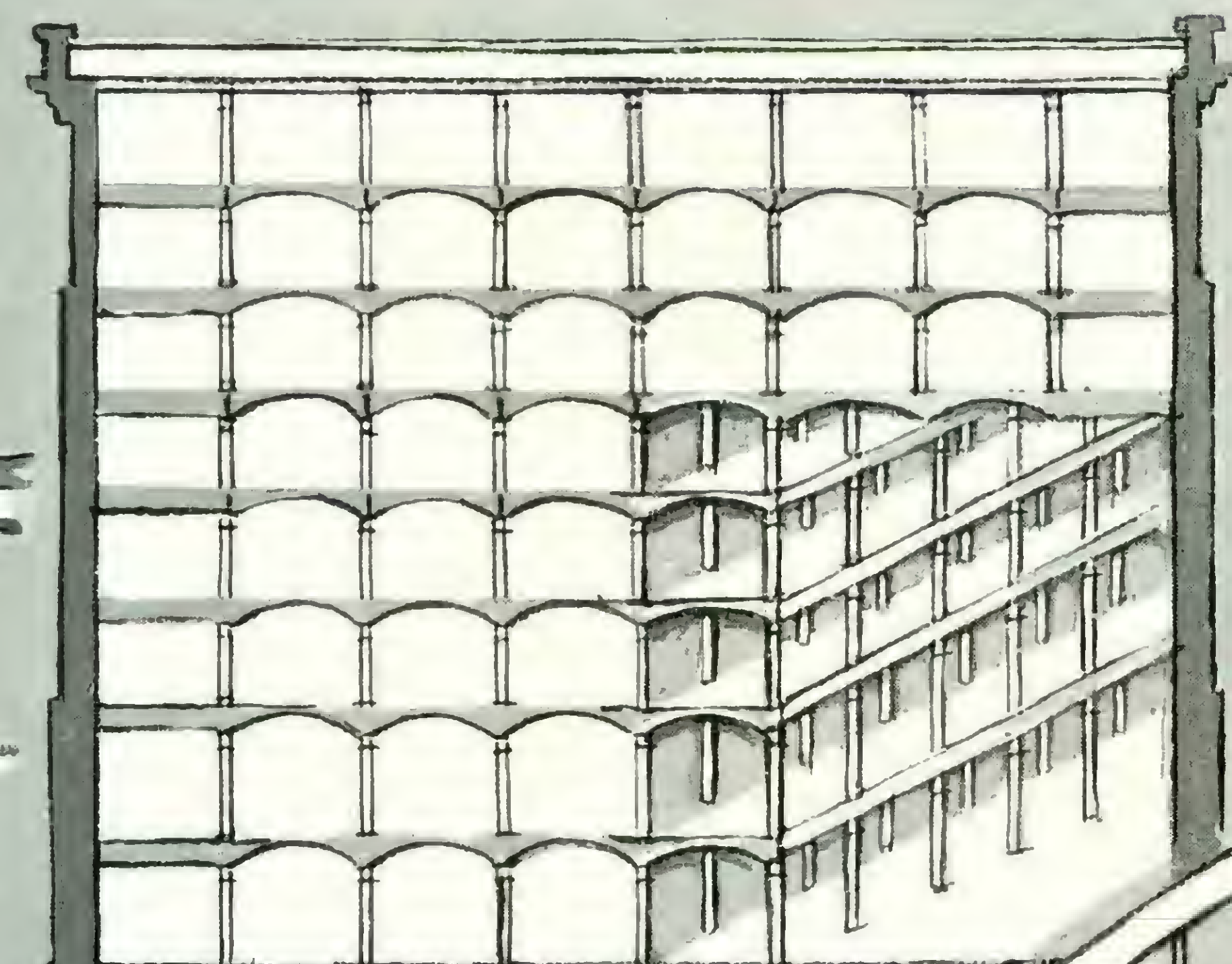
tension boom

S. / compression or strut  
T. \ tension or tie



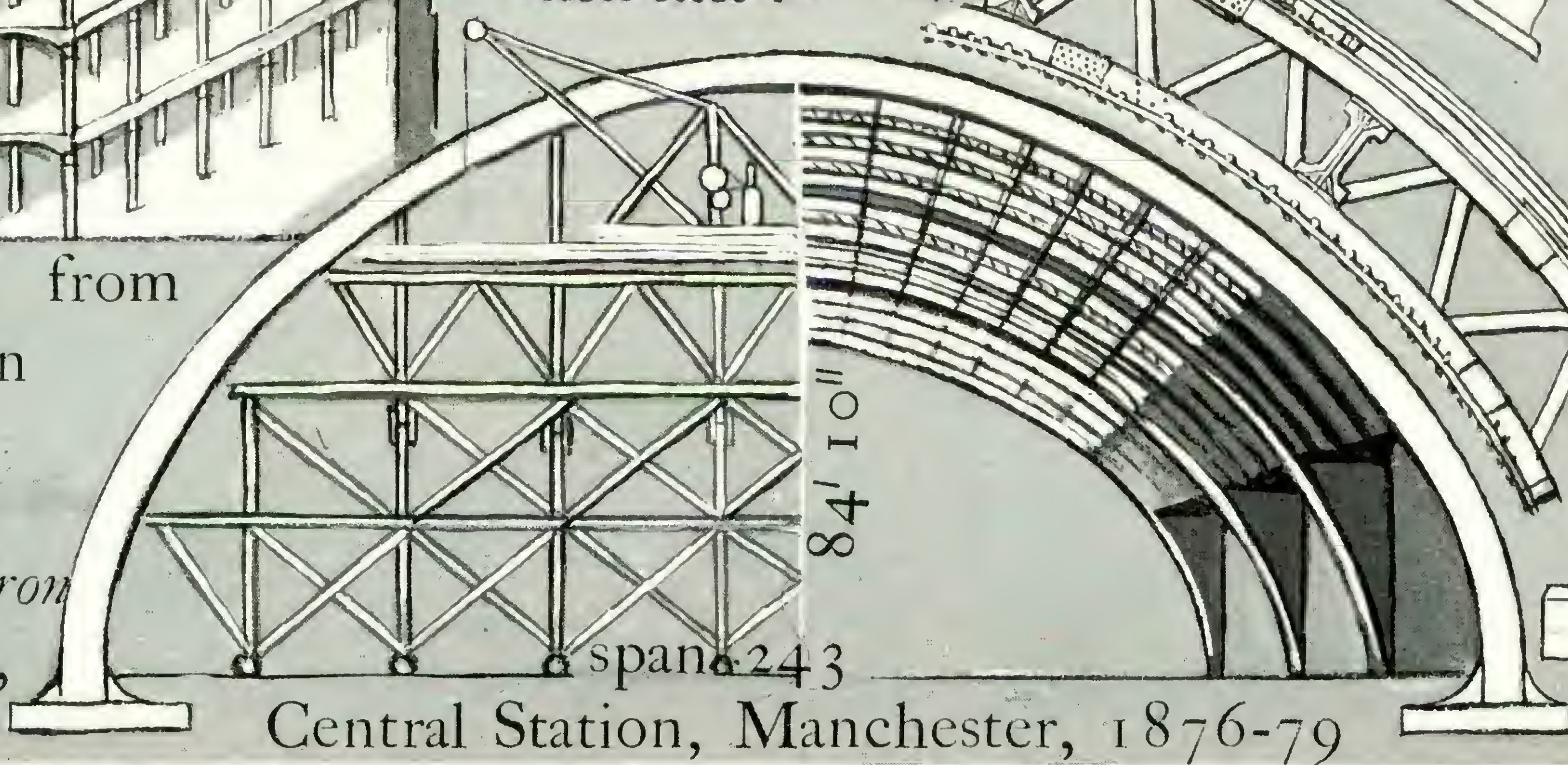
rivets

bolt



Sugar refinery, from *Sir William Fairbairn (1789-1874)*,

*The Application of Cast-iron & Wrought-iron to Building Purposes*, London, 1845



Central Station, Manchester, 1876-79

c.1845 Sir William Fairbairn

Cast-iron column and wrought-iron beams,

Cast-iron column, Victoria Station, London, 1861

Cast-iron column, Birkenhead, c.1876

Woodside Station, Birkenhead, c.1876



# CAST IRON, WROUGHT IRON, STEEL

Design for wrought-iron column: *Viollet-le-Duc*  
(1814-79), from *Lectures on Architecture*,  
Paris, 1863-72

Art Nouveau: cast-iron structure,  
Brussels, 1893  
*Victor Horta* (1861-1947)

The  
Crystal Palace,  
Hyde Park,  
London, 1851  
*Sir Joseph Paxton*  
(1803-1865)

Constructed  
in 17 weeks in cast-iron  
with pre-fabricated  
standardized parts and based  
on multiples of 24 feet  
standard glass size 49" by 10"

The  
Fair  
Building, Chicago, U.S.A., 1891  
*William Le Baron Jenny*  
(1832-1907)

The Eiffel Tower, Paris,  
1887-89. Constructed  
of wrought-iron  
*Gustave Eiffel*  
(1832-1923)

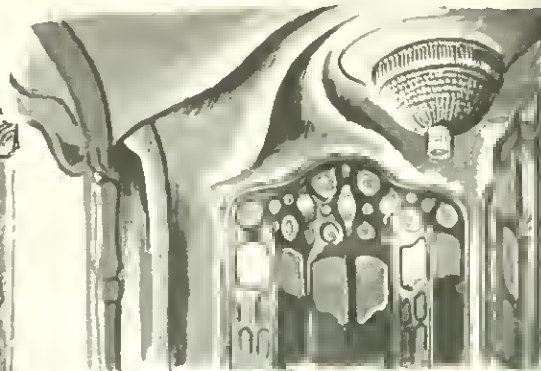
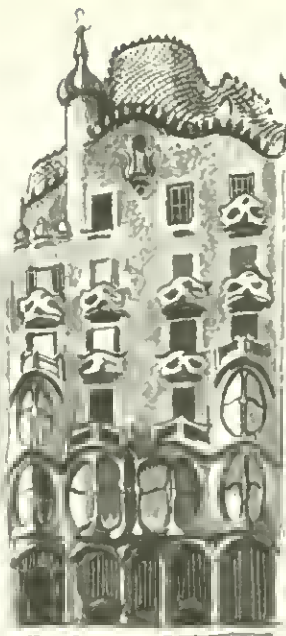
hinge  
base

Galerie des Machines, International Exhibition, Paris,  
1889: three-hinged steel arch *Dutert*, engineer *Cottamin*

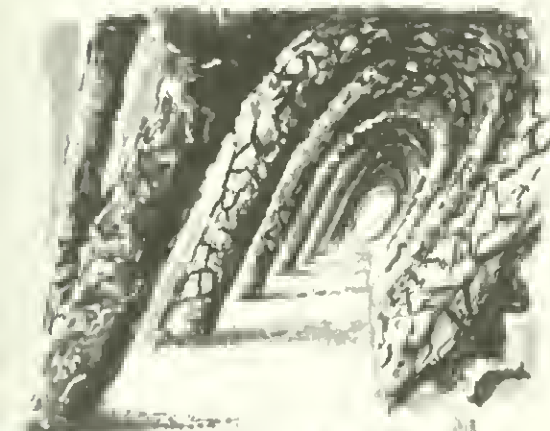
to which cross beams  
steel beams  
are rivetted to  
form a rigid framework



# 19TH & 20TH CENTURIES

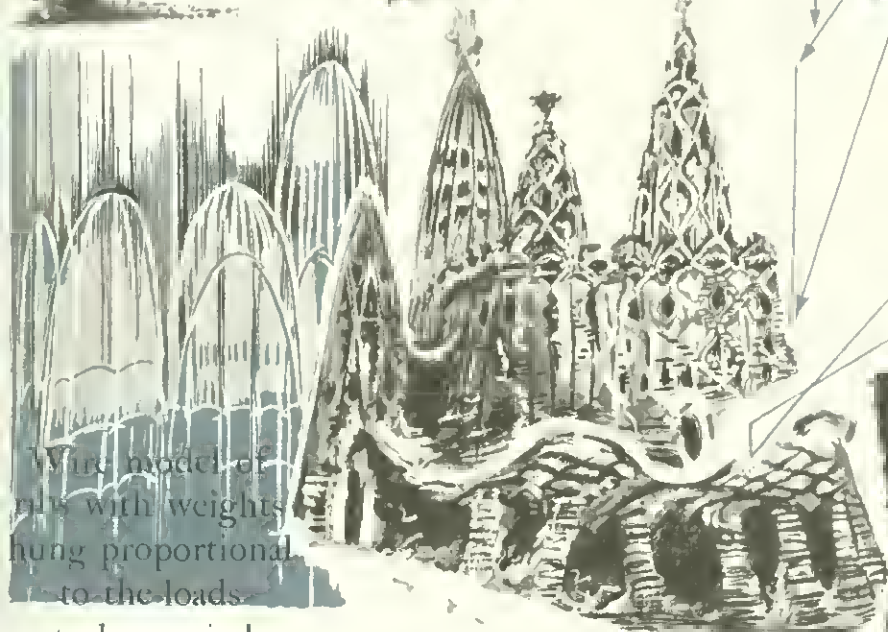
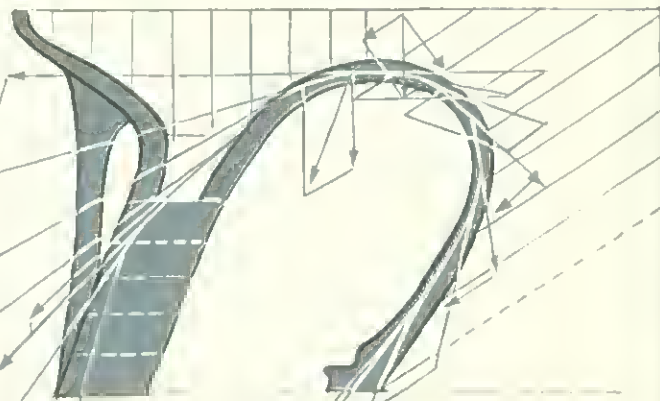


Casa Batlló ( 'House of the bones' ), Barcelona, 1903-07 *Gaudí*



Parc Güell,  
Barcelona,  
1900-14  
*Gaudí*

tilted  
helicoid  
columns



Wire model of  
russ with weights  
hung proportional  
to the loads  
to be carried

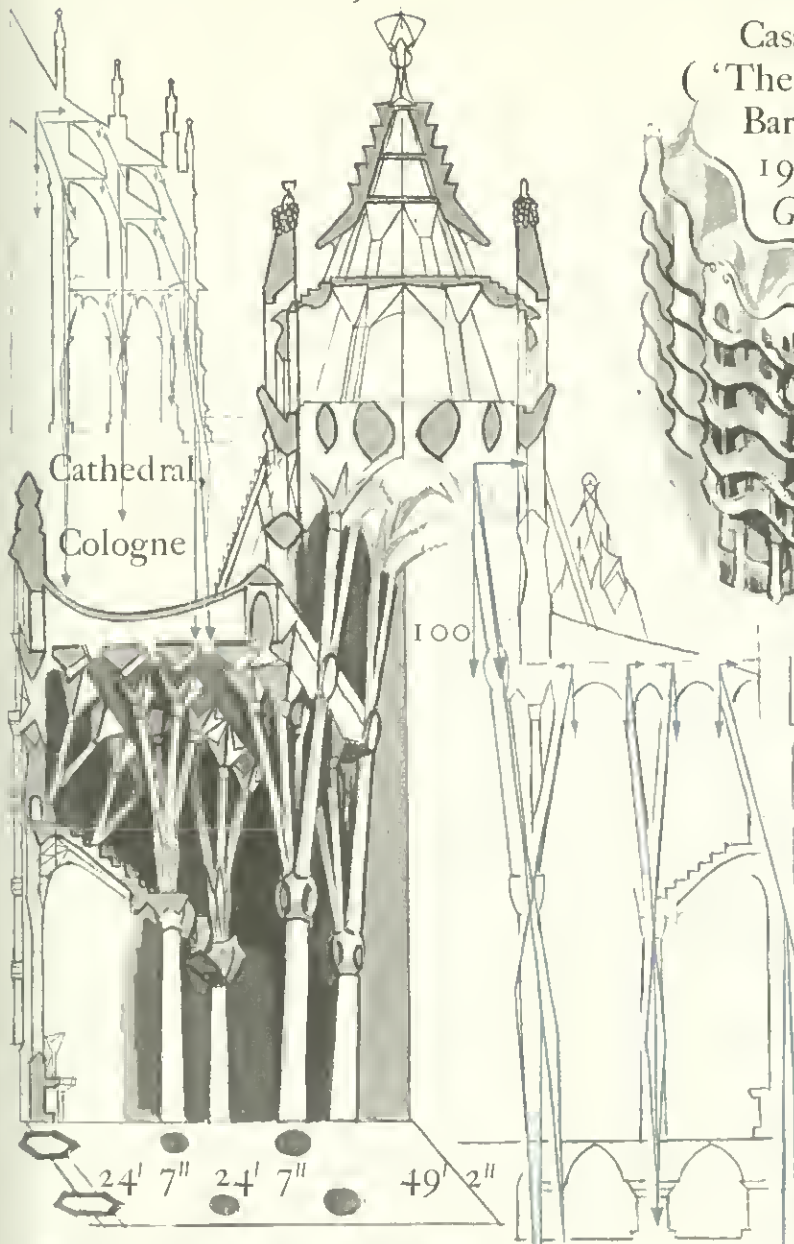


Project for Güell Colony chapel, nr Barcelona 1898-1914 *Gaudí*

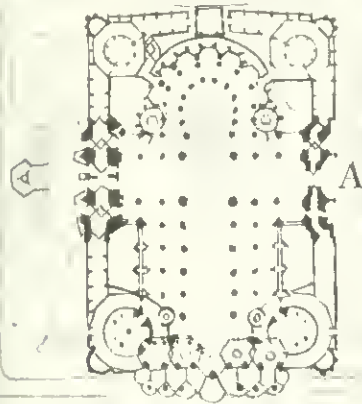
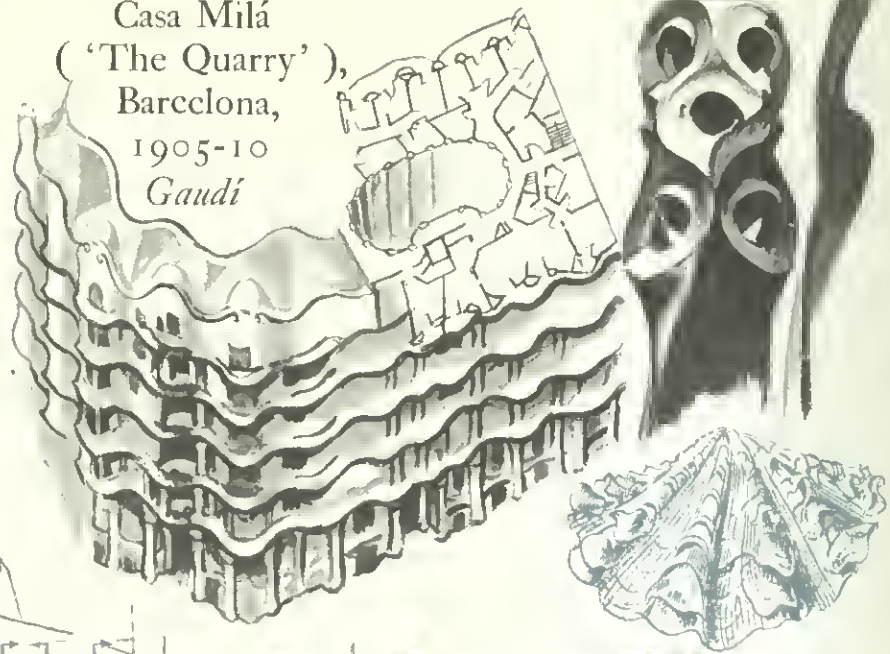
*Antoni Gaudí (1852-1926):* born Reus, near Tarragona; worked & died in Barcelona. 'Gaudí



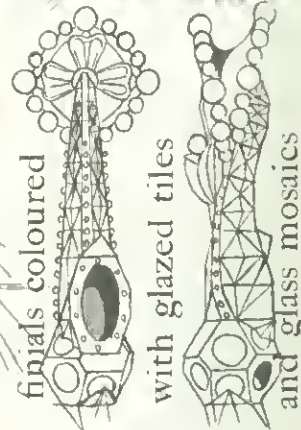
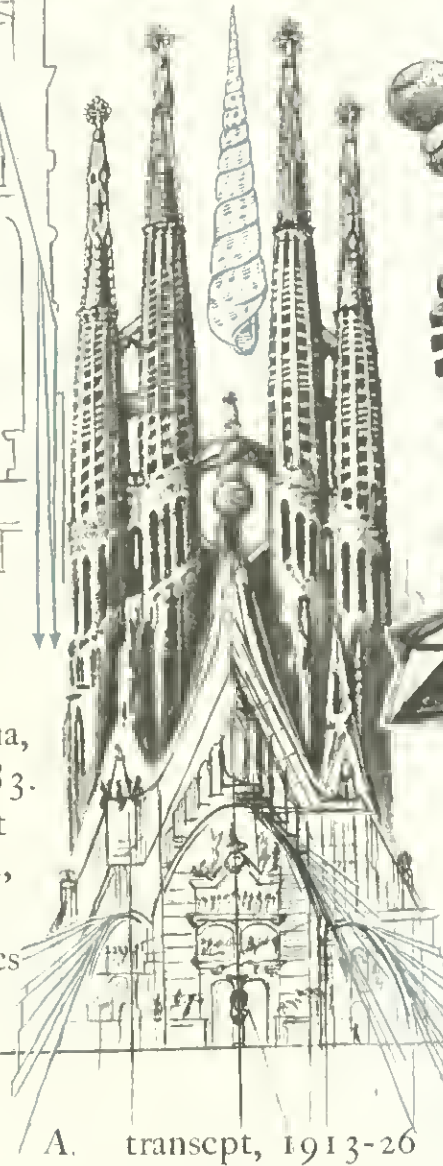
# SPAIN, MODERNISMO, GAUDÍ



Casa Milá  
( 'The Quarry' ),  
Barcelona,  
1905-10  
Gaudí



Sagrada Família,  
Barcelona, 1883.  
Unfinished at  
Gaudí's death,  
1926;  
work continues



A. transept, 1913-26

is the constructor of 1900, the professional builder in stone, iron and brick' *Le Corbusier*

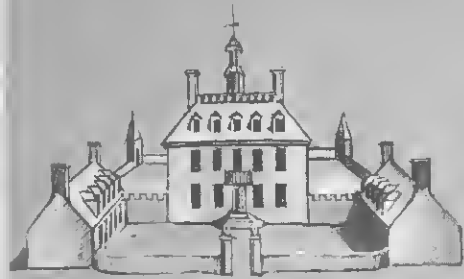


# 19TH & 20TH CENTURIES

Colonial or Georgian period: The Revolution  
influence of *Wren, Gibbs, Chambers & the Palladians*

Federal Period

Greek & Gothic

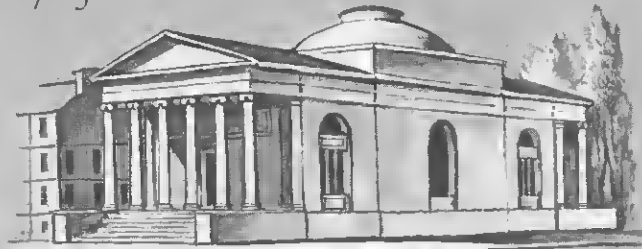


The Governor's House,  
Virginia, 1705 (rebuilt 1932)



St Michael,  
Charleston,  
South Carolina,

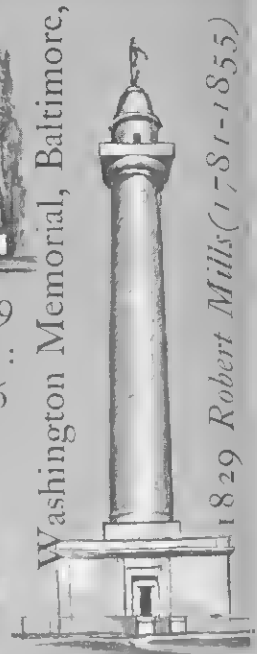
Westover, Virginia, c.1730 1761



The Bank of Philadelphia, 1798-99  
*Benjamin Latrobe* (1764-1820):  
born England; U.S.A. 1796



State House, Boston, 1793-98  
*Charles Bulfinch* (1763-1844)



Washington Memorial, Baltimore,

1829 *Robert Mills* (1781-1855)



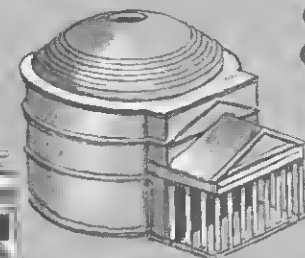
Redwood Library, Newport, Rhode  
Island, 1750 *Peter Harrison* (1716-75):  
born England; U.S.A. 1740



State House, Richmond,  
Virginia, 1785-96 *Jefferson*



Temple, Nîmes



the Pantheon,  
Rome



First  
design



University of Virginia, Charlottesville  
1770-1809

*Thomas Jefferson* (1743-1820); studied Roman buildings in Europe 1784-89



Trinity Church,  
New York, 1846  
*Richard Upjohn*  
(1802-1878)

University of Virginia, Charlottesville, 1822-26



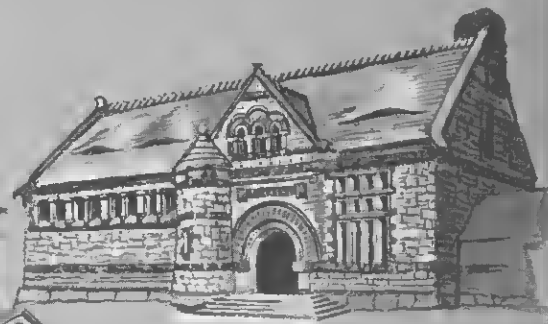
revivals

Civil War 1861-1865

The Chicago School 1883- (pp.168-9)



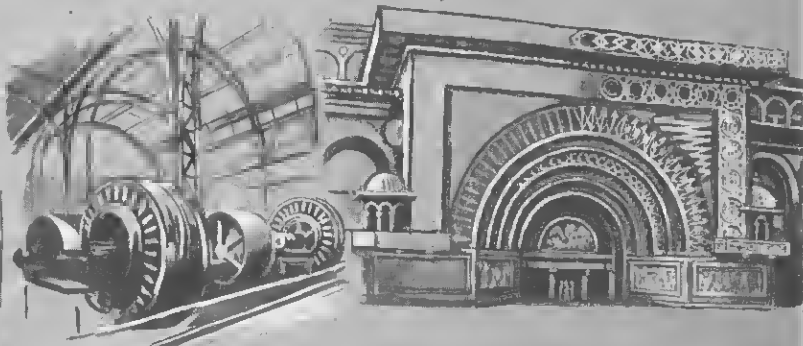
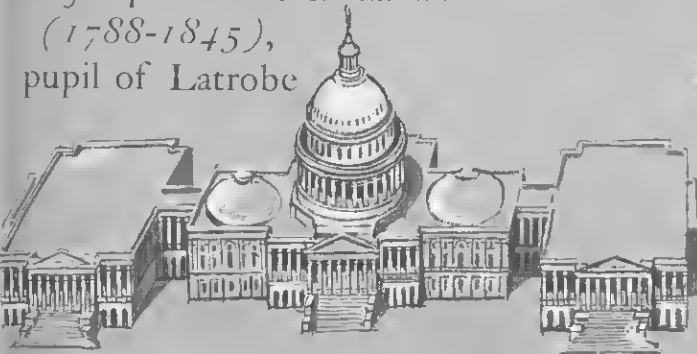
Romanesque,  
Salamanca



Crane Library, Quincy,  
Massachusetts, 1883

Exchange, Philadelphia  
1832-4 *William Strickland*  
(1788-1845),  
pupil of Latrobe

Trinity Church, Boston, 1872-77  
*Henry Hobson Richardson* (1838-1886) : studied in Paris

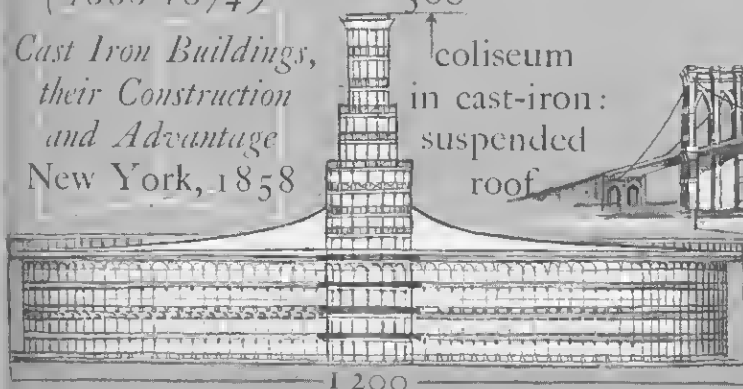


The Capitol, Washington:  
central block, 1792-1828,  
*William Thornton* (1759-1828) & others.  
Wings & dome (cast-iron), 1851-65  
*Thomas Ustick Walter* (1804-1887)

Transportation Building, Chicago Exposition,  
1893 *Louis H. Sullivan* (1856-1924):  
Paris 1874 *Frank Lloyd Wright* worked  
with Sullivan 1888-93

*James Bogardus*  
(1800-1874)  
*Cast Iron Buildings,*  
*their Construction*  
*and Advantage*  
New York, 1858

300  
coliseum  
in cast-iron:  
suspended  
roof



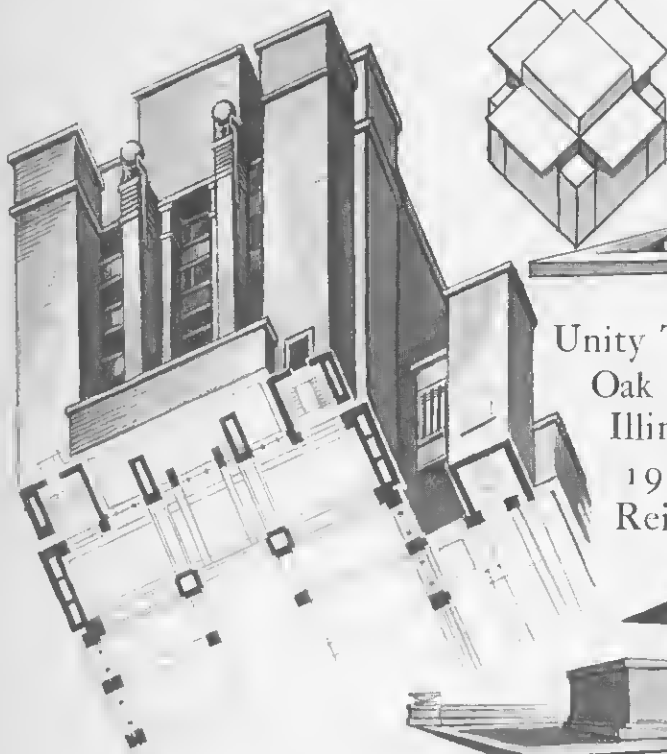
Project, New York World's Fair, 1853



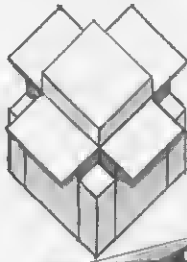
Brooklyn Bridge, 1869-1883 *John Roebling*  
(1806-69) & *W. A. Roebling* (1837-1926)



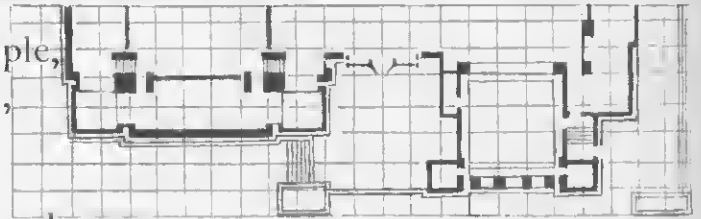
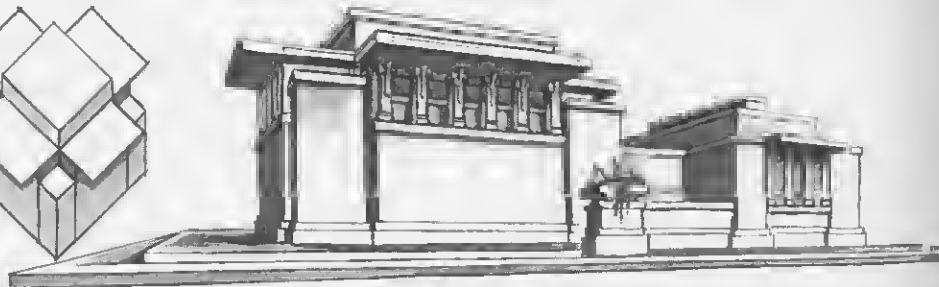
# 19TH & 20TH CENTURIES



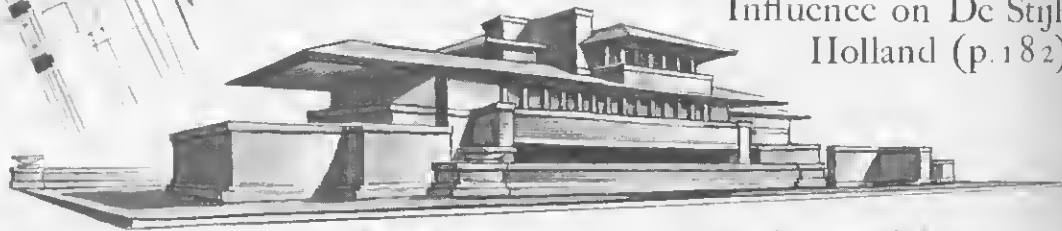
Larkin Administration Building,  
Buffalo, 1904. Brick



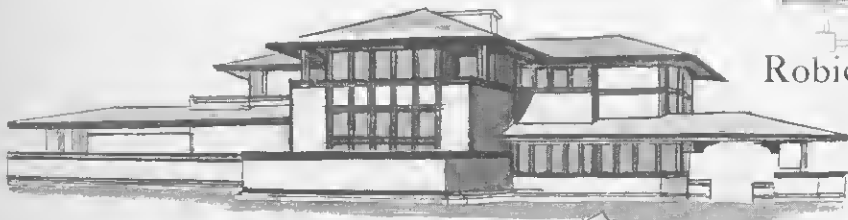
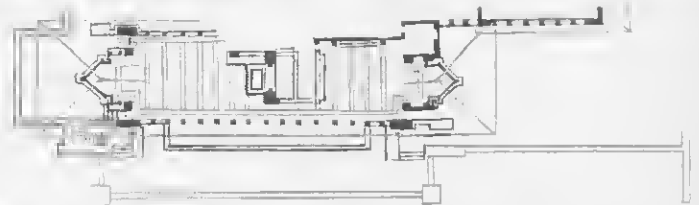
Unity Temple,  
Oak Park,  
Illinois,  
1906.  
Reinforced concrete



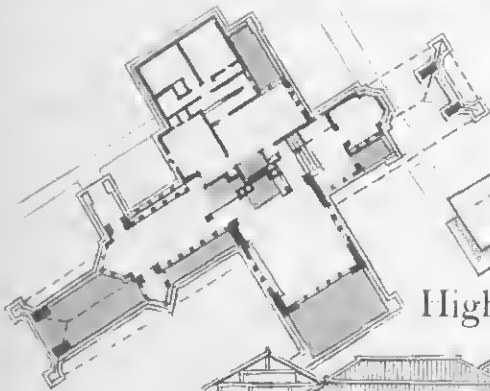
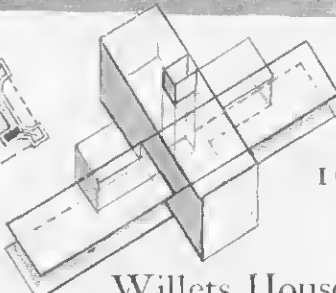
Influence on De Stijl,  
Holland (p.182)



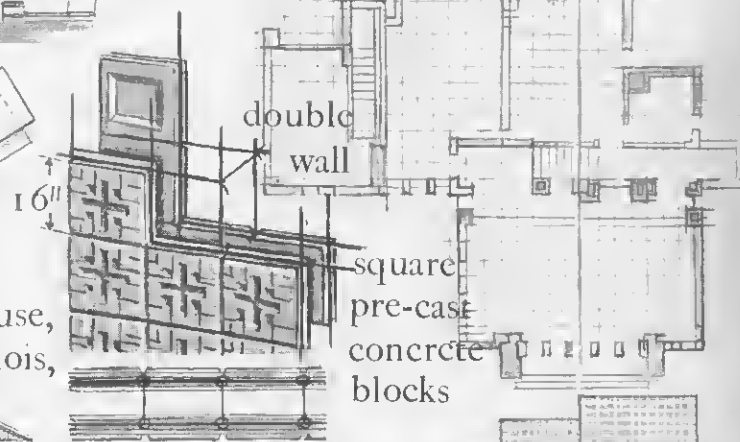
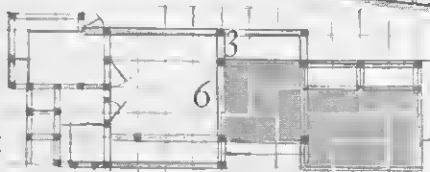
Robie House, Chicago, Illinois, 1909



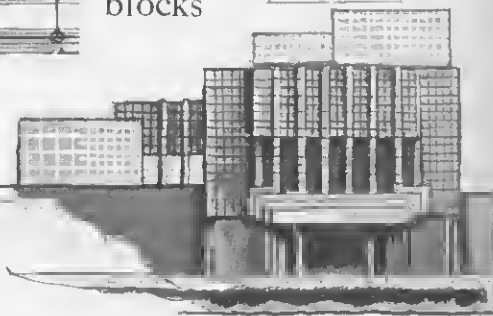
Willets House,  
Highland Park, Illinois,  
1902



Japanese house  
based on the  
standardized shape  
of mats 6 by 3 feet



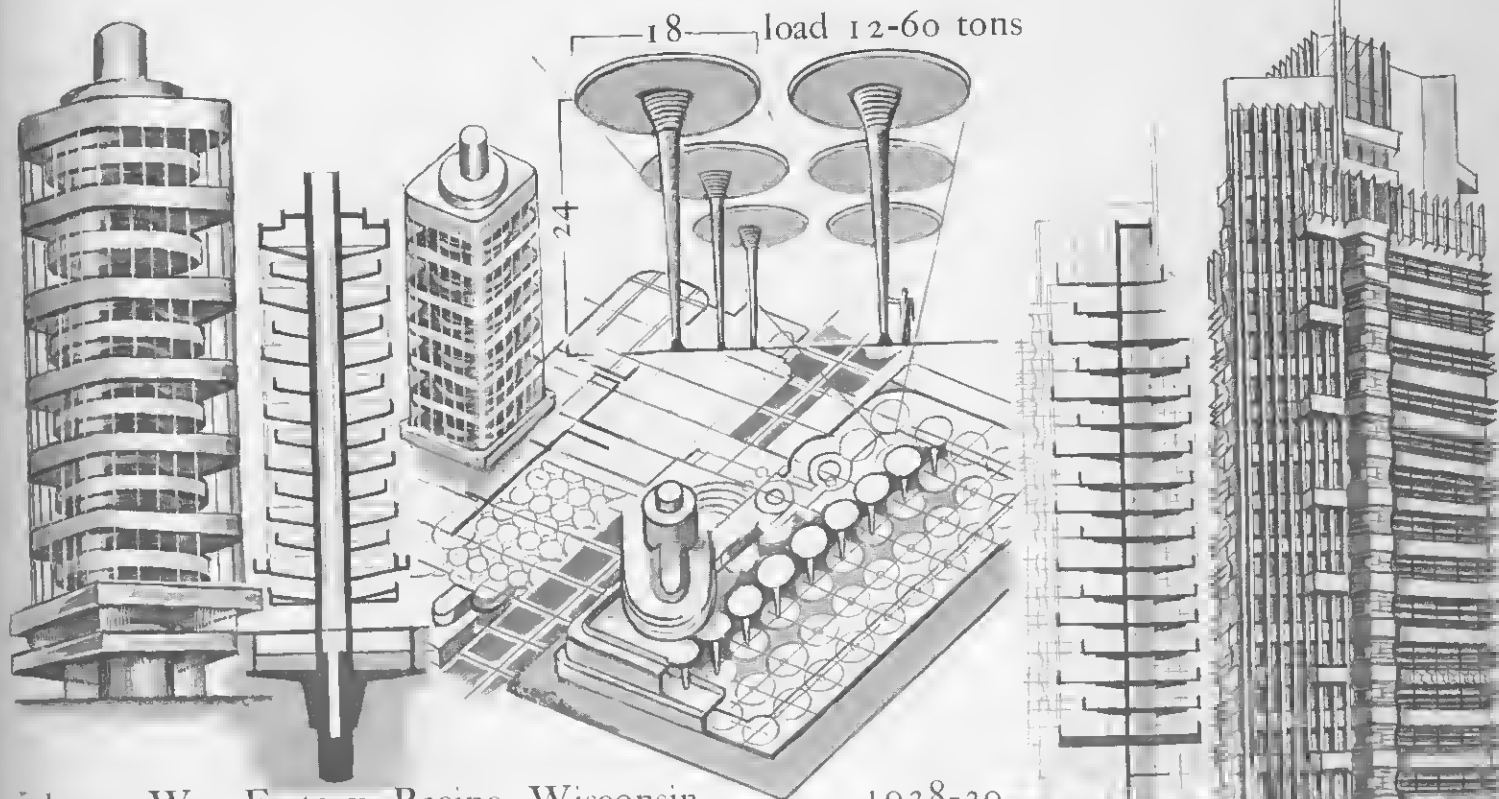
Millard House,  
Pasadena,  
California,  
1923



Frank Lloyd Wright (1867-1959), born Wisconsin, worked with Louis Sullivan 1888-93.



# U. S. A., FRANK LLOYD WRIGHT



Johnson Wax Factory, Racine, Wisconsin,

1938-39



Guggenheim  
Museum,  
New York,

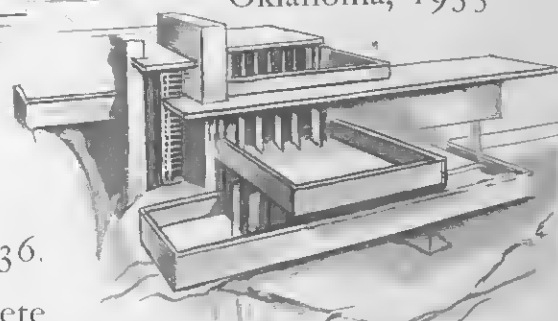
designed 1943-46, built 1956-59. Reinforced concrete



Falling Water,  
Bear Run,  
Pennsylvania, 1936.

Reinforced concrete

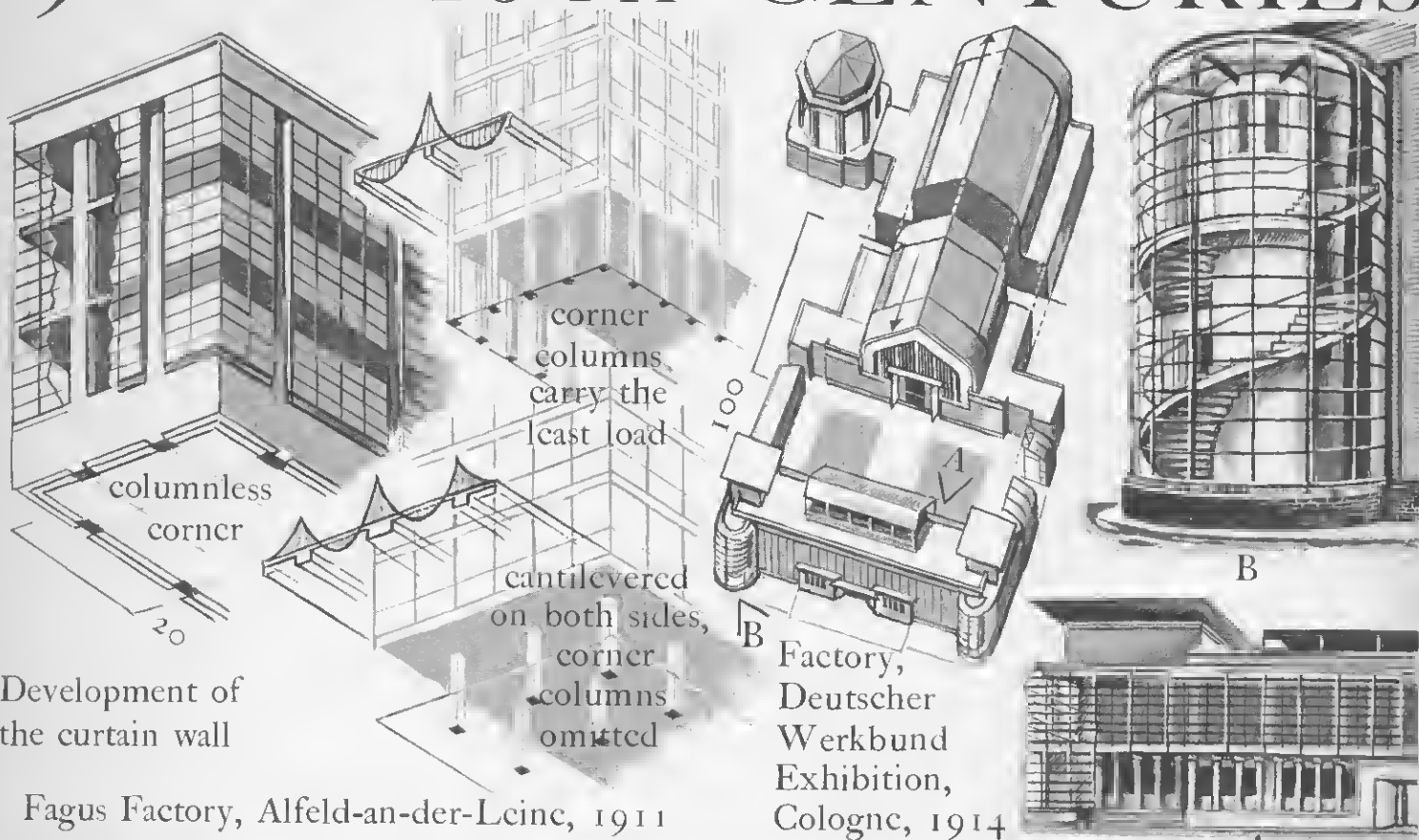
Price Tower, Bartlesville,  
Oklahoma, 1953



He innovated designs for an 'organic' architecture, kaleidoscopic in its variety



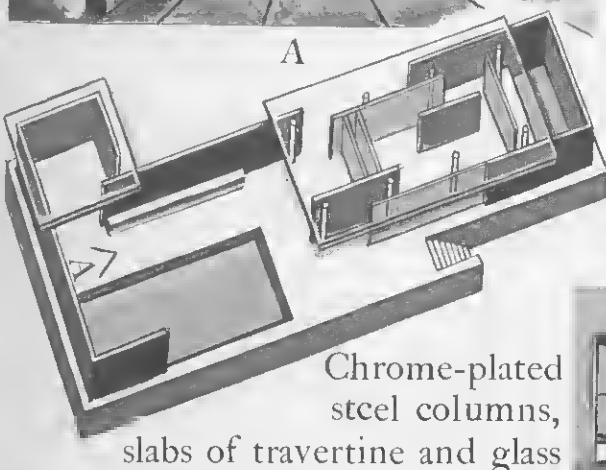
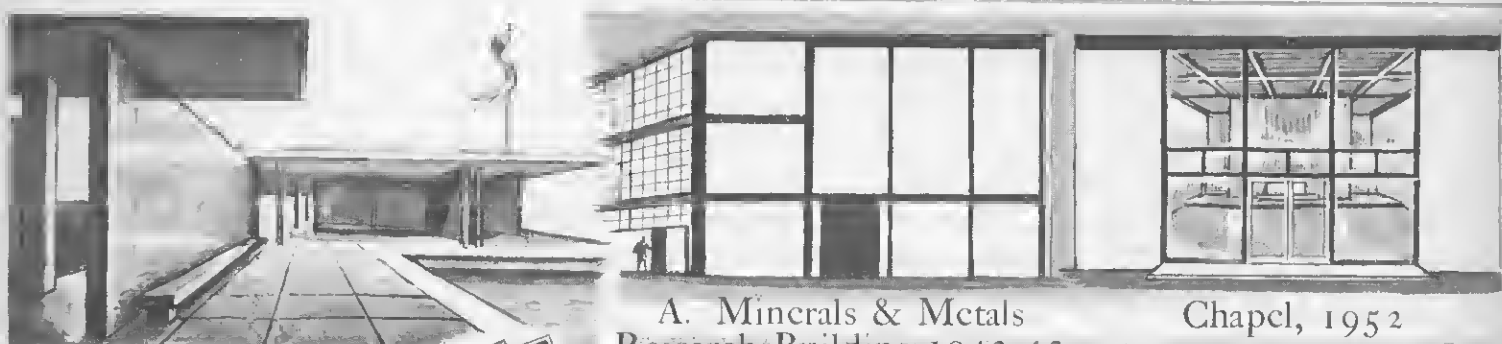
# 19 TH & 20 TH CENTURIES



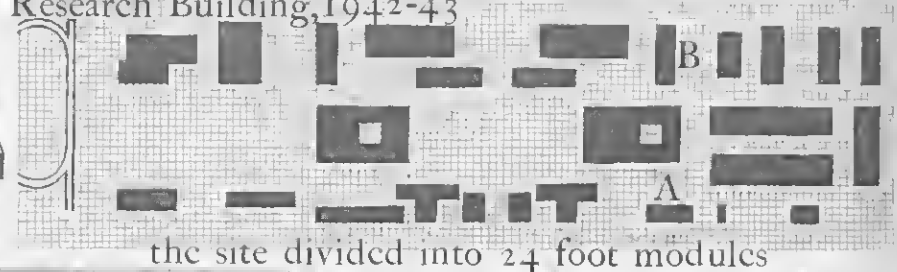
Development of the curtain wall

Fagus Factory, Alfeld-an-der-Leine, 1911

Walter Gropius (1883-): assistant to Behrens, 1907-11 (p.173); director of the Bauhaus,



German Pavilion, International Exhibition, Barcelona, 1929

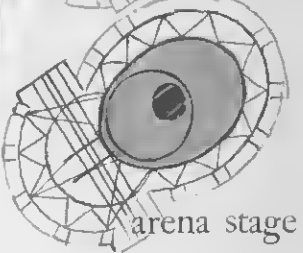
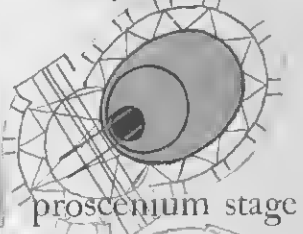
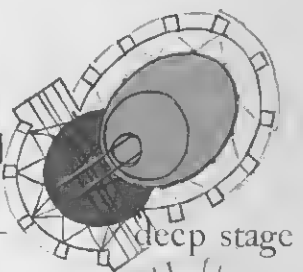
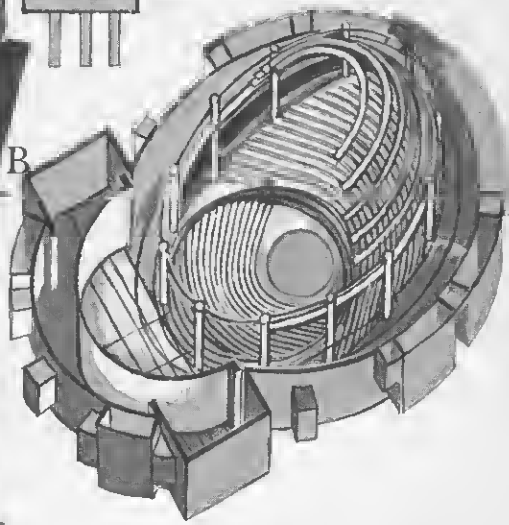
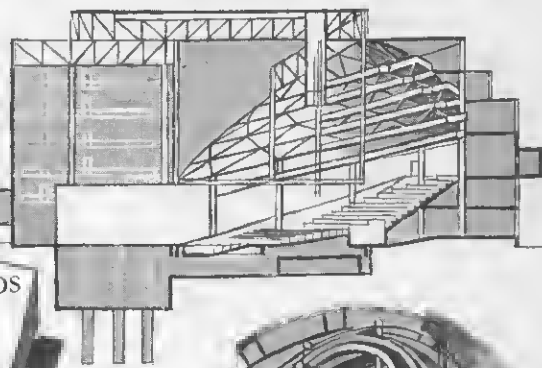
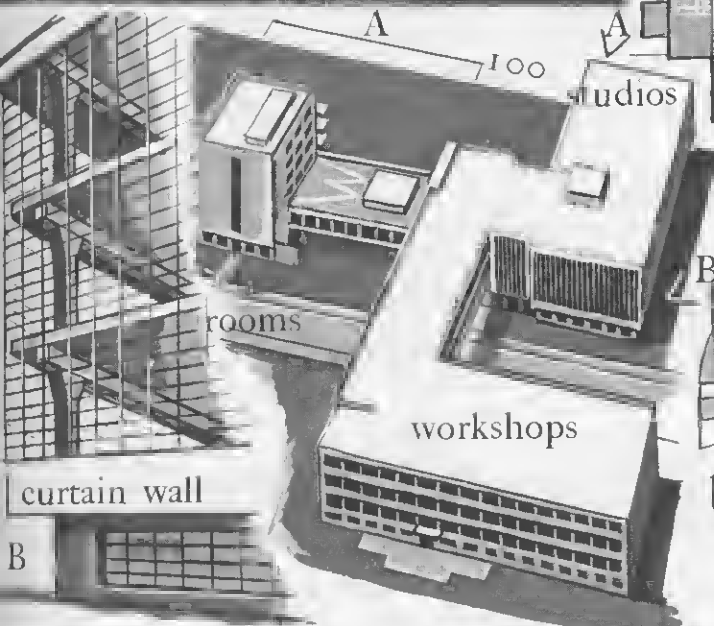
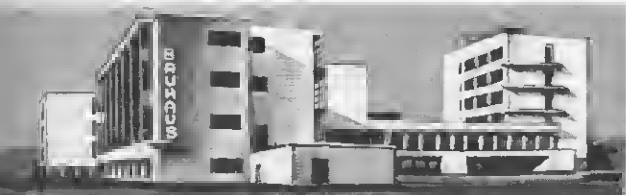


Illinois Institute of Technology, Chicago, 1940

Ludwig Mies van der Rohe (1886-): born Aachen, Germany; worked with Behrens 1908-11;



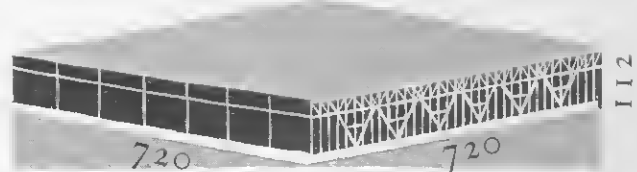
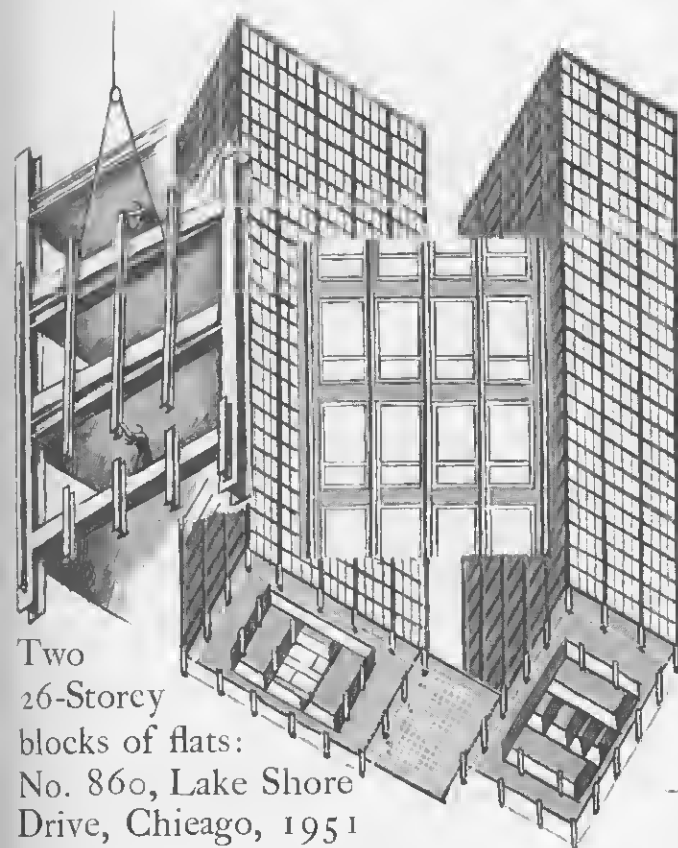
# GERMANY & U. S. A.



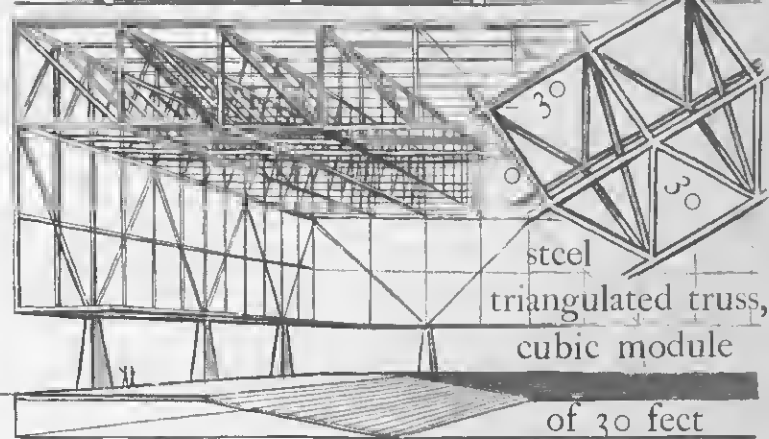
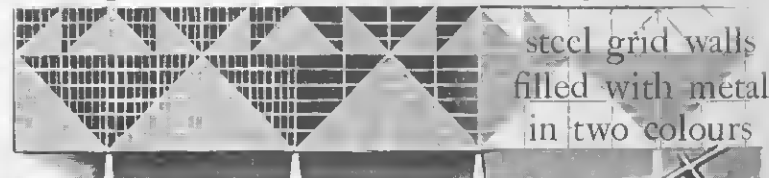
Bauhaus Buildings, Dessau, 1926.

Project: the 'Total Theatre', 1927

Weimar 1919-25, at Dessau 1925-8; worked in England 1934-37 (p.161), U.S.A. 1937



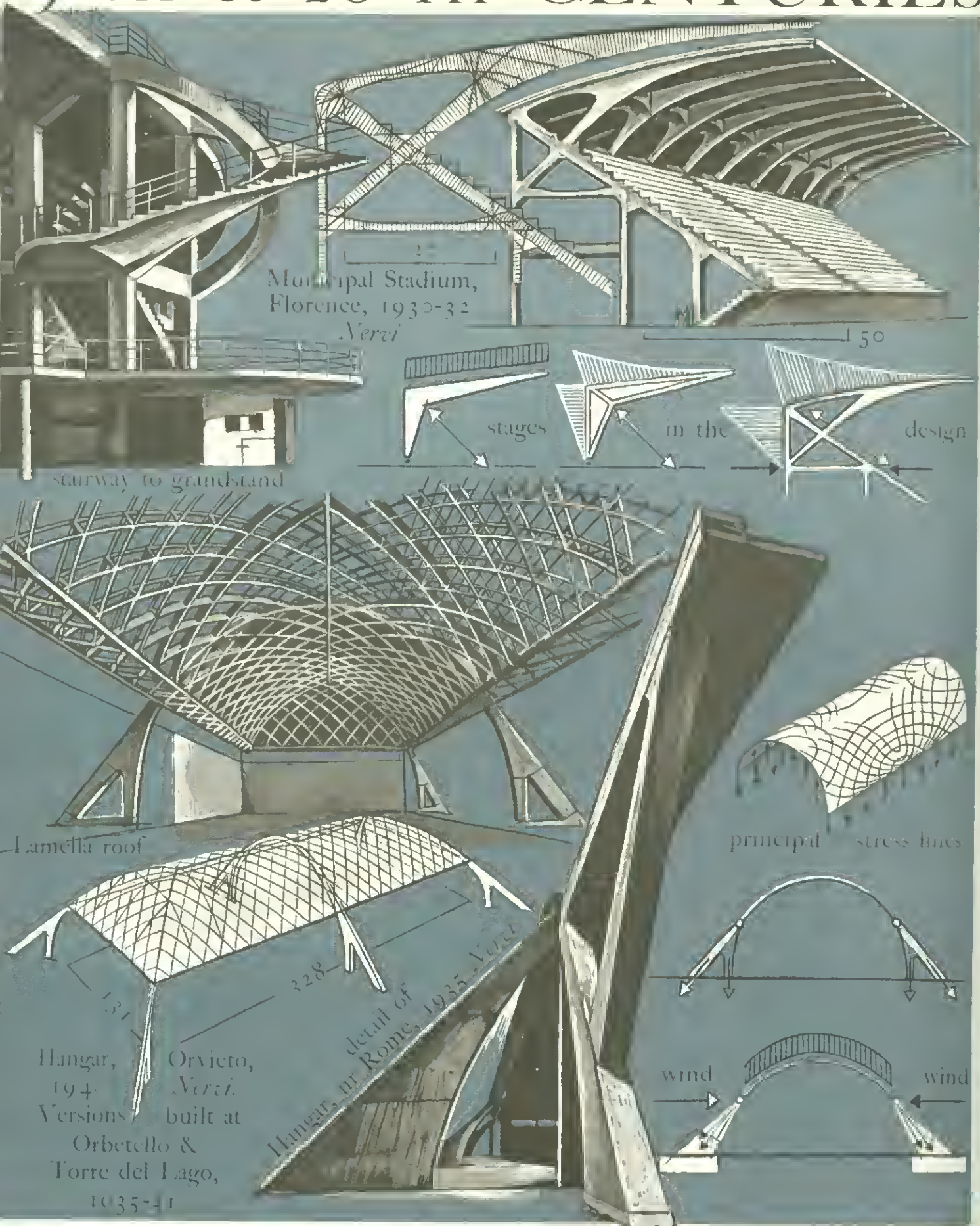
Project: Convention Hall, Chicago, 1953



director of the Bauhaus, Dessau, 1930-33; to U.S.A., 1937. His dictum: 'less is more'



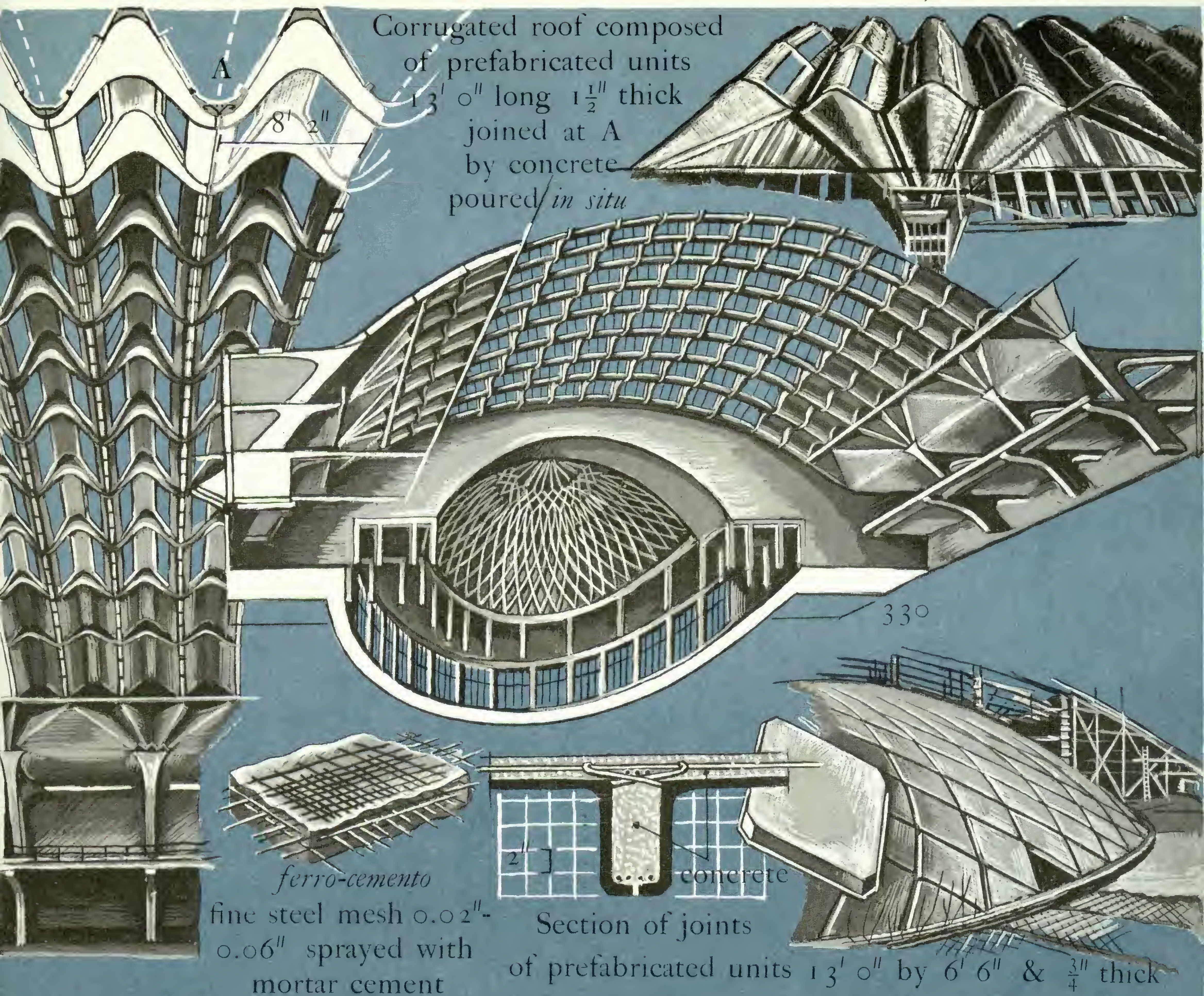
# 19 TH & 20 TH CENTURIES



Perí Luigi Nervi (1891-), born Lombardy, engineer in reinforced concrete, follows 'both

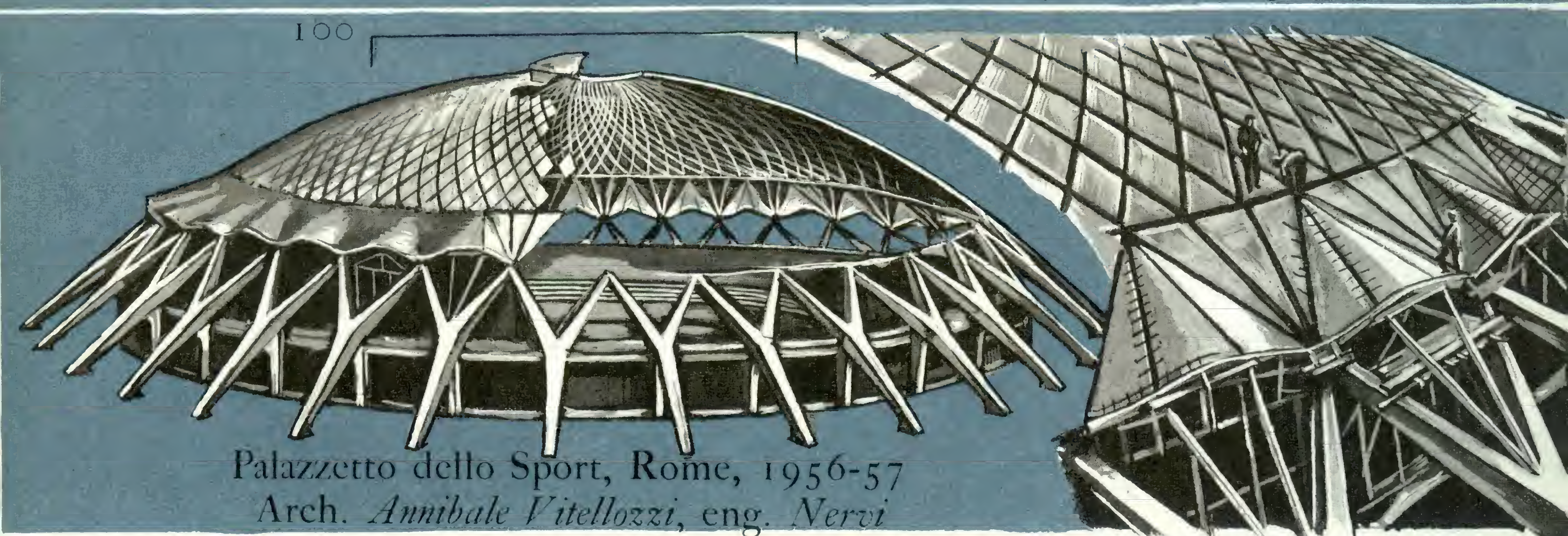


# ITALY, NERVI



Exhibition Hall, Turin, 1948-50

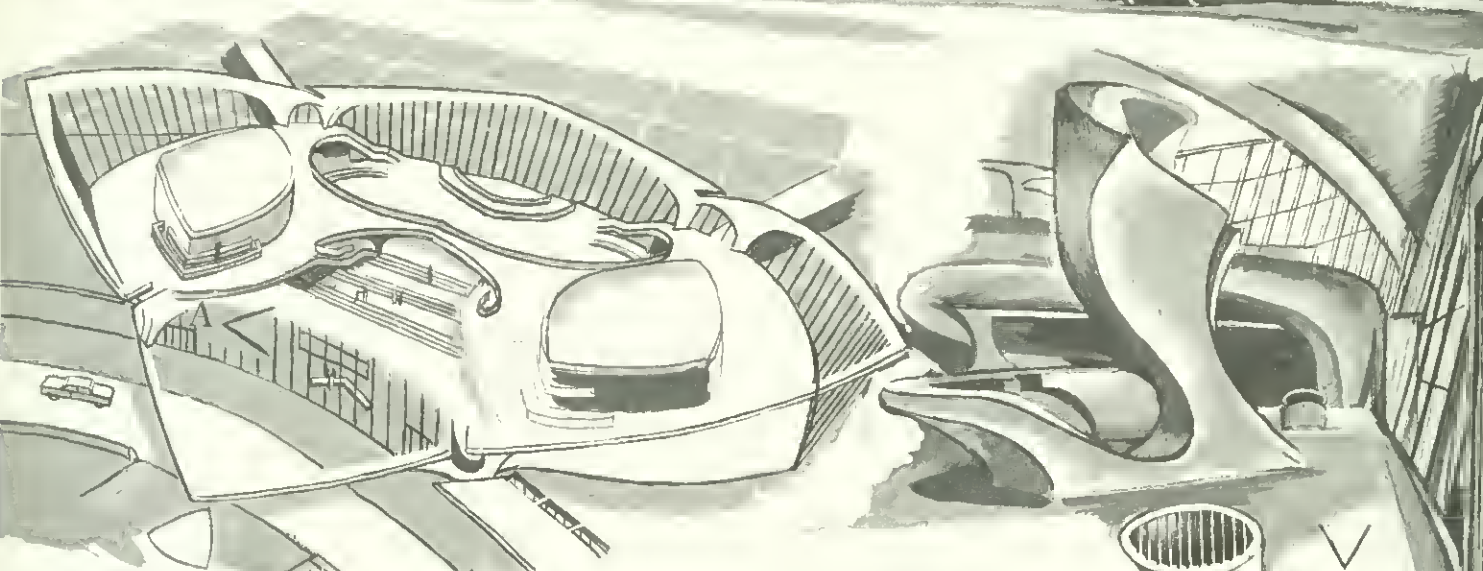
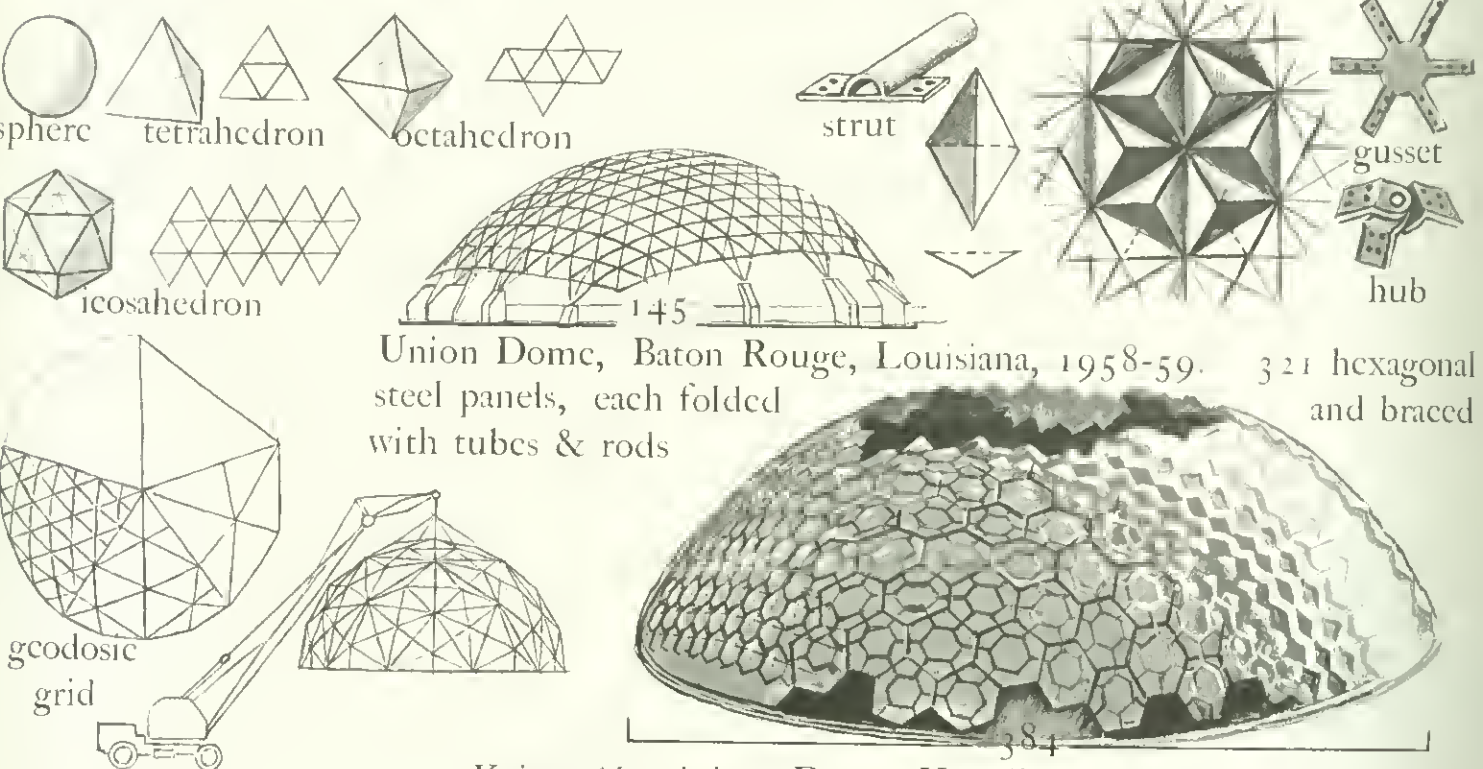
Nervi developed prefabricated units of *ferro-cemento* (iron-concrete), speedily assembled on a light scaffolding



the intuitive & mathematical paths'. Author of *Construction, Science or Art?*, Rome, 1945

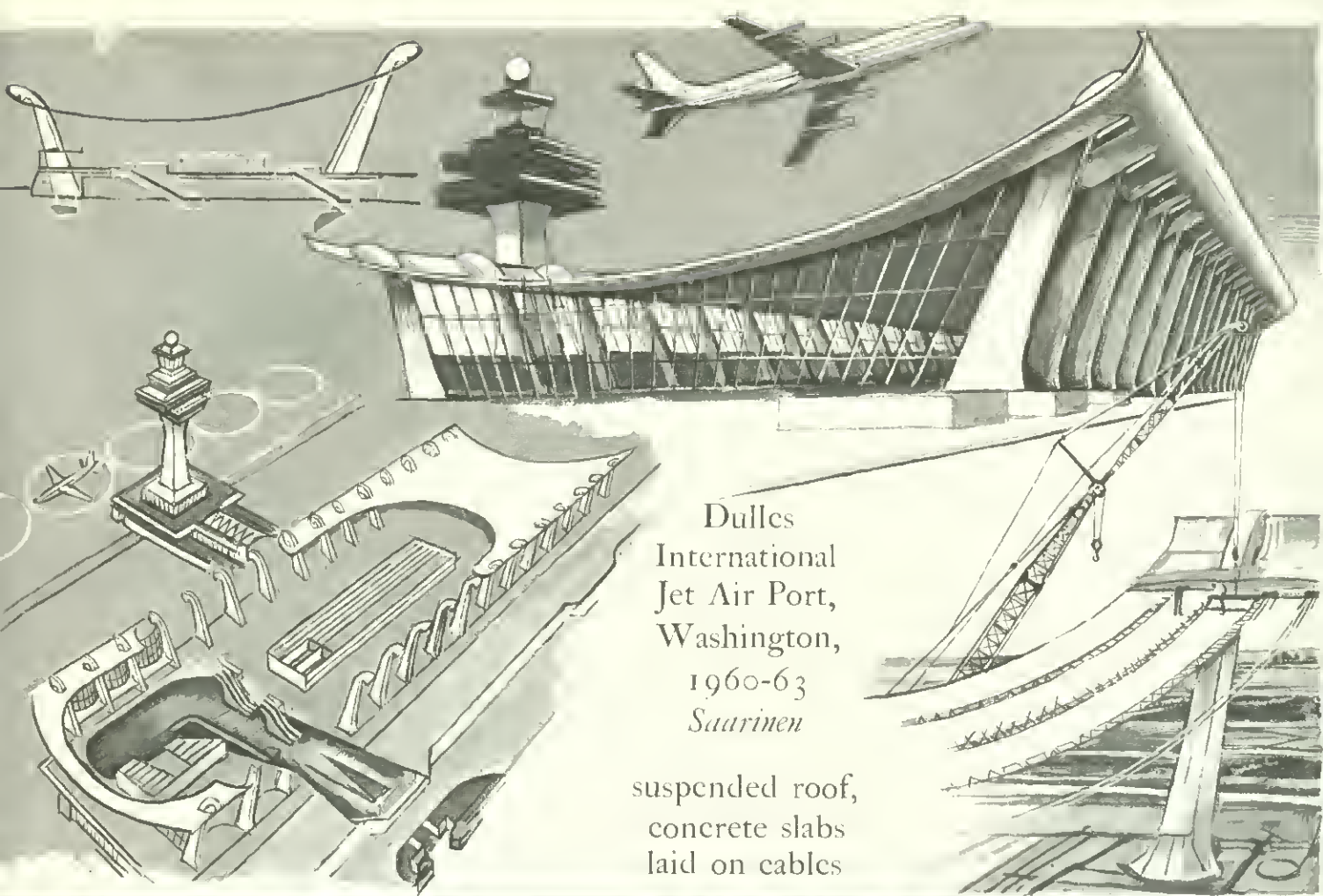


## A black and white architectural sketch of a modern building. The building features a curved, ribbed facade and large glass windows. A small car is parked in front of the building. The sketch is done in a loose, expressive style with visible pencil or pen lines.

V  
A

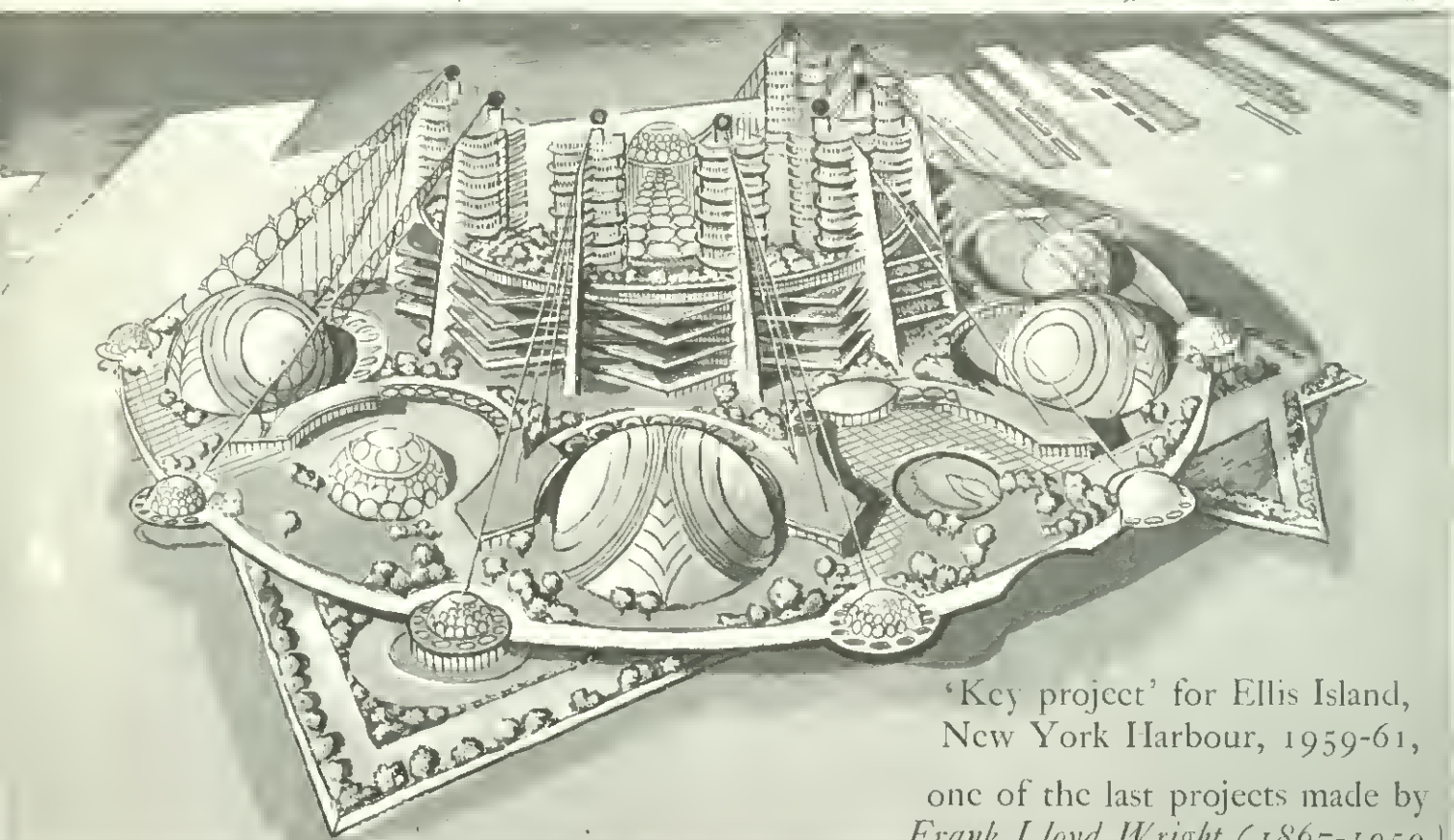
Kaiser Aluminium Dome, Hawaii, 1957. Erected in 22 hours  
*Richard Buckminster Fuller* (1895-), 'comprehensive designer'





Dulles  
International  
Jet Air Port,  
Washington,  
1960-63  
*Saurinen*

suspended roof,  
concrete slabs  
laid on cables



'Key project' for Ellis Island,  
New York Harbour, 1959-61,  
one of the last projects made by  
*Frank Lloyd Wright (1867-1959)*